Design thinking approach for customer understanding and interaction design in the Oilon IoT system development.

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Abstract

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Abstract

The main objective of this development work was to create the foundation of an appropriate business model that feels logical, desired and competitive for the user. The development research during this thesis allowed to shape and prove the interaction mechanism and factors that will support the new business and service creation around the Oilon IoT system. To succeed in this, an extensive stakeholder analysis allowed to identify them and subsequently proceed with close collaboration with the selected stakeholders in co-design workshops and with a qualitative approach so that semi-structured interviews generated the material. The development work was supported by using System-oriented design with Gigamaps tool, with the objective to keep visualized what was developed and the found elements in the focus area under discussion. The Gigamap tool allowed the visualization of the elements of a complex system and the interaction between them, maintaining a holistic approach where the discussion saw the customer always in the centre. Based on research results and its analysis, the project group has the basis for further development achievements and prototype testing findings to support the business model creation and advanced service solution of the Oilon IoT system.

Keywords

Design thinking, System-oriented design, stakeholder analysis, semi-structured interviews, IoT system.

CONTENTS

1 INTRODUCTION

Digitalization and the related technology's development have revolutionized many industries over the years, and this trend continues at an accelerating pace. The digitalization of professional services is changing the way business-to-business companies meet their customers and provide customer experience. Many companies have already bravely taken a long way on the industrial internet path, serving their business and customers. For these pioneers, industrial internet has become an integral part of everyday life in recent years. Industrial internet means a breakthrough, a disruption that shakes many industries in different continents. Some of the traditional companies continue to grow stronger through the new players created by the business models built on the IoT systems, but for some, the discovery is a threat. However, by boldly engaging in change, the companies are more likely to improve than endanger their vitality. (Collin et al. 2016, 12-17)

The thesis was developed during the initial phase of an internal project at Oilon Oy, which has the scope to create an IoT system that digitally connects monoblock burners. The system, once implemented, will allow to monitor parameters, follow trends and for instance, receive alarms that help increase the reliability and efficiency of Oilon's monoblock burners. This particular type of burner is a part of the core business of the case company. The work initially goes through an intensive analysis of the company's stakeholder related to the project; the output allows the project group to identify relevant stakeholders and the factors that have a significant impact on the project. Once the relevant stakeholders are identified, selected customers are interviewed, and subsequently, the collected material analyzed.

The development process described in this thesis aims to research and bring the customer needs concerning IoT application to the attention of the business-to-business project group. The specific case here concerns monoblock burners with the target to create an appealing business model that will serve the company's and stakeholders' needs. The design thinking approach was applied during the research and development of the findings because of its methods and toolkits that supports innovation and intelligent change. The purpose of the use of design thinking was also to commit the project group and workshop participants to positive thinking driven by creative thinking and human-centred approach (Curedale 2015, 18). The methodologies used were designed to structure a shared understanding from different perspectives and increase the project group's interaction. Additionally, the motive for using a design thinking approach was to solve the right problems and develop the right services.

Sustainable growth and the need to remain relevant in the market is pushing many companies to update their business models and, in many cases, bringing IoT solution into them feels like an obligatory step. This thesis opens up the discussion and methods for joint achievements with different company silos and moves the IoT project forward to meet stakeholder needs. The thesis ends up with the crystallization of the findings of this development research that enables the creation of different business models based.

IoT systems are a vast opportunity that will allow businesses to lead towards improvements in the response of time and quality, allowing a customization of the products and the services. Because of these accomplishments, companies will have a much more real-time understanding of consumer need (Pal et al. 2017, 16). Innovative product and services in the market of the IoT area can build a sustainable business that can be then translated for the consumers in the reduction of costs, experience benefit and improvement of operational efficiency through monitoring (Pal et al. 2017, 21). IoT system of the type the Oilon is developing needs user eccentricity to be successful. Technological development is not enough to create a sustainable business model; data has to be wisely translated to fulfil the need of the users, providing the expected experience.

2 CASE COMPANY, RESEARCH QUESTIONS, DEVELOPMENT WORK METHODS AND FRAMEWORK

2.1 The case company Oilon Oy

Oilon Oy, the case company in this thesis, is a family-owned energy and environmental technology company founded in Lahti in 1961. Oilon manufactures and sells oil and gas burners, which are the traditional businesses in the company portfolio. Oilon is characterized by a brand that promotes environmentally sustainable operation and social responsibility. Oilon, in its brand philosophy, shows its intentions to minimize the environmental impact and maximize operational safety by continuously developing their product, operations and quality standards (Oilon Oy 2019). Ground source heat pumps and industrial heat pumps were introduced into the range of products offered by Oilon around the year 2000. In this way, Oilon has also become involved in the utilization of renewable energy sources meeting the trends that expect new sources of energy accounting for 40% of the increase in energy. Also, the use of natural gas grows much faster compared to oil and coal, supporting the energy mix needed for the increasing demand of energy (BP Energy Outlook 2018, 15). The company operates mostly in business-to-business markets and is engaged in both domestic and international trade.

Still, in 2019, Oilon's most significant businesses are oil and gas burners which are sold worldwide by following the destination country regulations. As Pekkola (2017, 8) reminds the world trade in burners is characterized by emissions and their reduction. The emission regulation puts the use of oil and gas to produce energy in an advantaged position compared to coal, which is less environmentally friendly fossil fuel. Even if the latter would easily and cheaply be provided as an energy source, its emissions push many companies to choose to avoid it. While coal is cheaper to extract, gas emission reduction through the burning technology is much more convenient than the one available for the coal. Also, for this reason, coal plants are being transformed into gas-fired plants around the world.

Pekkola (2017, 9) also states that in the year 2017, and the situation had not yet changed; the world does not have a standard set of rules on emissions and requirements. For example, the European Union, the United States and China have their own. Emission requirements are currently the factor in the burner market that creates a competitive situation between manufacturers. In the burner trade, manufacturers must first reach the required emission limit to enter the bidding process. When the emission requirement is met, manufacturers will start competing with other factors affecting the trade, such as possible brand image, price, technological advances and services.

2.2 Monoblock burners and Iot solutions

Oilon burners, classified in monoblock and duoblock burners are used to produce energy from heat to electricity. Oilon burners represent the latest technology that serves the demand of real estates, industry and their processes, power plants and marine applications. Burners, whose combustion technology benefits of low emissions and high-efficiency capacity, can burn several fuels from both, fossil and renewable energy sources. The monoblock burner is characterized by a unique machine that provides through a motor and a fan wheel the airflow and the pressure needed for the combustion. Duoblock burners have the burning air canalized from a separate device. Forced draft burner is used in the most common industrial and real estate application, and their power ranges from 12 to 29500 kW. The (FIGURE 1) represents Oilon's burner family.

FIGURE 1. Oilon burners (Oilon internal marketing material)

The Internet of Things has many different definitions. At its fullest, it can include all devices connected to the Internet. Most commonly it refers to devices, sensors and objects that are connected to an existing Internet network and can, for example, detect their environment and communicate the data that originates from a certain operation. The operation of an IoT structure relies on an intelligent system that works over the Internet; it has a selected automation system or application that controls the process and allows devices and sensors installed to send the data to the cloud, from which the control system can extract it (Pal et al. 2017, 15).

IoT solutions make remote access easy. It is possible to operate an IoT system from any device like a computer, smartphone or smartwatch that permit the visualization of the data transferred from any physical object embedded with electronics, software, sensors and as long as the device has internal network rights. Because IoT-based solutions work over the Internet, it is necessary to take into account system security and to set security standards. Many companies use IoT technology together with data analytics, but even with intelligent use of sensors to monitor quality and production, it can be vastly data intensive. The aim is to capture the relevant information and use it to improve products and services. Since IoT technology is based on the internet network connection, cloud services and server systems data processors can be on a different continent from the source of data to be interpreted (Pal et al. 2017, 15).

The system works via the cloud, and through IoT, the Internet of things, all the data for conscious planning of activities are aggregated and transformed into useful information. The data can be accessed even remotely and from any mobile device, so that data relating to the progress of connected machinery can be consulted at any time via a customized dashboard or interface monitors. Furthermore, by using a specific analysis and business intelligence platform, the use of data becomes intuitive and straightforward with the goal to utilize the results in the decision-making process of the company (Collin et al. 2016, 209).

The case company Oilon, during the past years, has been working with different connection systems that allowed the users to be connected to the burners or to the logic that controls them. Systems previously developed, and still partly in use on Oilon's products, have different characteristics compared to the one in this study. The specifics in this case presented in the (FIGURE 2), frame the device to be an embedded system on the monoblock burners, already installed on the burner and able to be connected to the internet whenever the commissioning of the product happens. This facilitation makes the introduction of the system much more comfortable and its use only a matter on a simple registration to the services from the final user.

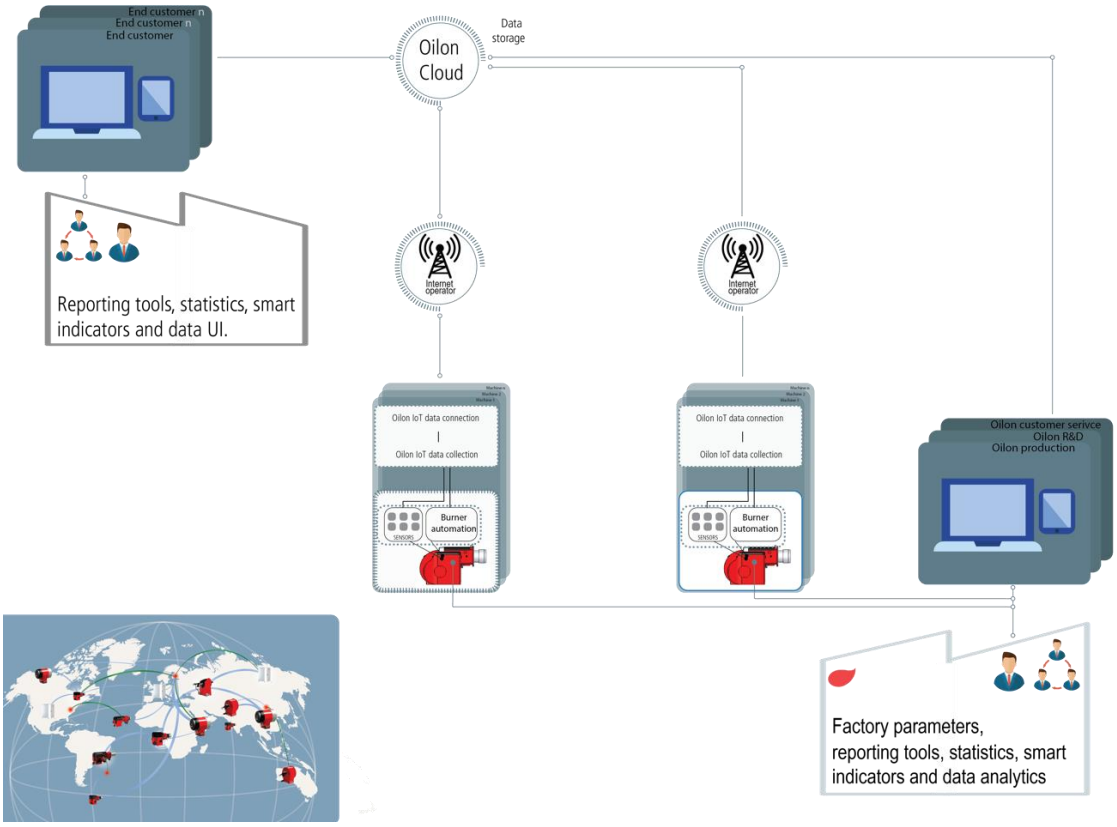

FIGURE 2. Oilon IoT system architecture simplified, representation of the basic working idea (Danelon)

Pal et al. (2017) explain that the typical architecture of an IoT system (FIGURE 3) presents three subsystems. The sensor subsystem which has sensor devices that basically as transducers, converts energy from one form to another, so the data acquired can be read and digitalized as an electric signal. The gateway subsystem connects the local sensor network of the sensor subsystem to the public network, which can be the Internet.

The last one is the cloud subsystem which receives, stores and allows the visualization of the data produced by the sensors and sent through a gateway subsystem which can be for instance a router connected to the internet.

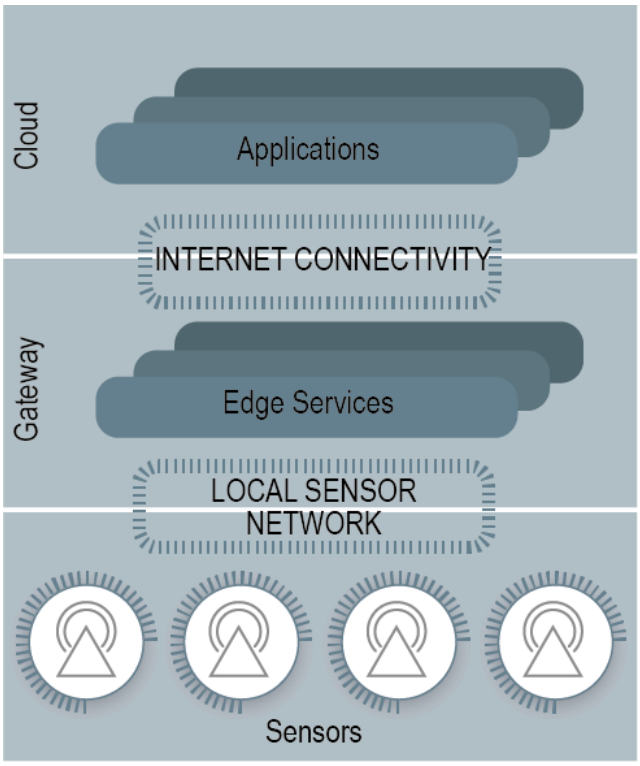

FIGURE 3. IoT technology stock (Pal et al. 2017). Typical architecture of an IoT system (Danelon)

It is one thing to acquire mountains of data and another to put it together effectively to improve results. Those who do the latter, register an increase in production efficiency of 15-20%, according to surveys carried out by Terino et al. (2019). The productivity rise goes hand in hand with the quality and flexibility increase, also in terms of visibility and access to information. Terino et al. (2019) state that with the connection of IoT systems, the way products are manufactured is changing, but so is work, sales and even a transition from the core business to a new business. Change in the business model opens new doors to new perspectives. Connectivity and sharing have indeed paved the way for new ideas, previously unimaginable business. For historical and more structured manufacturing industries, connection and sharing create an impact on the entire chain. As Collin et al. (2016; 47) state, the value created jointly and individually by the companies in the chain is no longer the same, as the entire value creation formula must be recalculated. The industrial internet is breaking down old business models and creating new ones as the company's relationship with its customers and products is deepening significantly. Until now, the relationship between the product and the customer after the sale has been mainly limited to after-sales service. The emergence of new services through the industrial internet creates a much stronger bond between the company and its customers. Each

customer receives a wealth of information about the products they use, alerts for maintenance needs, or improper use of the equipment, and can make changes to the software settings themselves. Within companies, a revolution affects all core functions, not just production, product development and information technology, but also leasing, sales, marketing and customer service.

2.3 Development framework and objectives of the research

Oilon's willingness to broaden its market approach and the necessity to adopt new business models by integrating information technology systems gave the designer a chance to introduce the development project framework (FIGURE 4). This type of development allows the organization to investigate different technical options and still support the focus on the user and for this reason, design thinking was chosen as the approach method for this development work. Also, the techniques in use, endorsed the ideation and evaluation of solutions designed, even considering the complexity of the system and today's highly demanding business ecosystems and customers. Getting closer to the users will help in this challenging environment, but design has to be taken seriously in the organization to succeed and get the most from the design methodology. (Idean et al. 2019, 22-23).

This chapter, briefly explains the objectives of the research, the framework that structured the thesis and the study developed within, together with the methodologies utilized.

FIGURE 4. Thesis framework consisting of the methods and the goal of the development work (Danelon)

The purpose of this study is to research, analyze and describe what the real needs of the stakeholders related to IoT system installed on Oilon's monoblock burners are, to create a business model that would support the strategy of the company. The research problem is addressed through the following research questions:

1. What are the main stakeholders needs considering IoT technology on Oilon's monoblock burners?

2. What are the key drivers of value in IoT technology applied on monoblock burners?

3. Which are the means for possible business models aligned to the company strategy?

The desire to develop solutions to a need or bring a change can be the starting point for a research development work. Research and development usually involve production of new ideas, practices, products or services that resolve practical problems (Ojasalo et al. 2019, 19). Design thinking seeks to solve problems pragmatically through collaboration, and it also typically focus on what is the real problem. It possesses capacity to work successfully in complex environments, based on the process to consider all the variabilities, collect them and communicate them well. Designers are well suited and trained to cope with all this complexity. The ability of designers to synthesize solutions from fuzzy material makes it possible for the project group to quickly understand what the possibilities and constraints related to IoT systems are (Sevaldson 2013, 1). Clarity and visualization remove communication barriers, unifies group dissimilarities and make possible member involvement during the project development (Sevaldson 2010, 17). In this development work, the design thinking methods exploited allowed the group to work in an intense and curious way.

In general, companies that do not benefit from design thinking methodology tend to jump right into solutions after a short problem-definition phase, without further study (Norman 2013). Design thinking takes enough time to define the problem itself and tries truly to see the issue from the perspective of the product or service users. Design thinking is an approach, that with the sensitivity of the designer and the variety of design of tools will combine people's needs, technology, and commercial strategy into a functional entity. This entity brings value to the customer and also enables the business of the company (Brown 2009, 86). The methodology applied, also permitted to a multidisciplinary group to move towards the analysis of real users' needs.

The thesis moves across the analysis of the stakeholders that are influenced or can influence the project. Bringing to light significant stakeholders allows the development group to

invite them to a more intense collaboration like co-design activities and semi-structured interview in the following phases of the development work.

As Bilgeri et al. (2015, 2) mention, assuming linear value chain from supplier to focal company in IoT systems is not good enough. For capturing the value-added on the system, the traditional way to illustrate and visualize must be substituted by a more efficient mapping tool. A system map is a blended name to call a different way to visualize or physically represent the elements of a system. System maps include a wide variety of elements as people, stakeholders, processes, structures, services, physical and digital products and more. System maps can visualize both the present and the future conditions of an ecosystem (Sevaldson 2013, 14).

During the whole development work, System-oriented design was on the background for demonstrating, dealing and supporting the development of a complex, interactive system of information. System-oriented design methods utilized the design thinking approach to reveal a detailed understanding of what are the information sources and the essential flows in the system. System-oriented design with Gigamaps tool, helps to keep visualized what is developed and the found elements in the focus area under discussion. In this way, the development group have all the time decisions, and problems visualized even in a complex environment. The Gigamap tool helps for co-inquiry where experts, users and other stakeholders come closer into a common dialogue understanding the systems inquired (Sevaldson 2015, 1-2). The method provided the tools to maintain the information and developed area tight together even when the discussion brings up new ideas and concepts.

System-oriented design is particularly useful in the hands of designers, considering their ability to deal with the complexity that comes from the holistic overview of the design thinking methods and interrelation between systems in discussion. System-oriented design allows changing the attention from object focus to systematic interventions, experiences and interactions (Sevaldson, B. 2013, 2).

One of the duties of the designer during this development work was workshops facilitation. Considering the course of studies and his experience in the use of design thinking methodologies, the designer implemented the elements of facilitation while still participating in content production workshops. In some cases, the designer added tools that positively influence the work and in other cases, he behaves neutrally in the decision-making situation, but still encouraging the discussion. Kantojärvi (2012, 40) writes that a facilitator does not produce or criticize ideas, nor does evaluate whether there are enough ideas or decide which one’s are the best. The group will do this. The facilitation also has to be able to

get the entire group focused on the same target at the same time, maintaining clear guidelines of the process and workshop goals. The facilitator has to take care of the documentation allowing the group to focus on the target.

3 DESIGN THINKING APPROACH IN THE DEVELOPMENT WORK

3.1 A change in design

The thesis was developed during the initial phase of the Oilon IoT embedded system's development project. The main target of the whole project was to create a new business model related to Oilon standard products with a focus on global customer service and product development that relies on proactive service, reporting tools and data monitoring.

The global competition pushes successful companies to concentrate on the combination of data gathering and the ability to offer the best digital services. For this, there was a need for a more holistic approach that takes into consideration products, services and people. The dynamics of the businesses must follow the customers' demand for providing good experiences as Miettinen (2017, 151 - 154) points Mäkelä's ideas. Oilon is, excellent in dealing with technical solutions, but the case project considers the inclination of the markets towards service proposals. The intention was to bring the relevant stakeholders to the centre of the development discussion and bring their opinions to the attention of the project steering group. As Miettinen (2017, 33) wrote, the service design process does not just find its path gathering and showing customer understanding to the company but mostly preparing the case company to the development of the service design process. Design thinking is the melting pot wherefrom the service designer gets the insight for the design development. Miettinen (2017, 34) explains that to be successful, this phase requires participation from key partners and ongoing marketing activities in the company. It is critical that the company's strategy shows intention towards service development. Allowing the approach used in this study, the company enables customer need perspective to the company structure and strategy.

The design thinking methodology was widely used to differentiate the approach in this study in an environment that usually has a quite technical orientation. For this reason, an explanation of what is the meaning of design thinking and how it evolved to the present stage, conduct the reader to understand the choices during this thesis.

Design often refers to the process of design and the resulting end product, that are related to the design of products and their aesthetics (Järvinen et al. 2001, 23). Design, at its current stage, has evolved from a product's appearance and its industrialization management to a more strategic problem-solving process. It has gone through a change over the years to a role for the creation of business success and improved quality of life through products, systems and services. The know-how of specific methodologies that before were

only in designer's hands now is utilized by a larger group of developers with significant attention towards users and stakeholders (Aminoff et al. 2010, 3).

As Aminoff et al. (2010, 3) state, the role of design has changed much in the past decades, and it is still evolving, enlarging the design methodology to be also used for brand building and usability. Van Patter (2003, 16) takes into consideration the new position of the designer and the needed skills to face up the complexity of the nowadays work. Aminoff et al. (2010, 3), also put into light the transition of design from a separate functioning discipline to a multidisciplinary environment.

It is difficult to define the concept of design considering the diversity of its applications and activities. The traditional areas like product, industrial and packaging design, for instance, might not be enough to visualise the design field. To be able to define design from different perspectives like sociology, technology and organisational science, Van Patter (2003) analysed and divided the design into four levels. The first level, D1.0, is the more traditional one that groups art and craft-based design. The second level, D2.0, is placed for the product and service design where the development focuses on the product and services of an enterprise from a user perspective in cross-disciplinary teamwork. The third level, D3.0, contains a design for strategic problem-solving. It is similar to the second level but with the target of problem-solving instead of producing products and services. The last level, D4.0, involves social planning, describing and is utilise open innovation models.

Antonelli (2019, 22) refers to the IDEO definition of design as a creative approach to problem-solving that starts with people and ends with innovative solutions that are tailor-made to suit their needs. The research of the most elegant and meaningful solution is the meaning for success while moving in a complex system.

As Aminoff et al. (2010, 16) report, in Finland design started to have a role between engineers and marketers for product development, but design path emerged to the current role in organizational and operational planning. Like in many other companies in Finland, also at Oilon the evolution of design has started in late nineties with an aesthetic approach considering only the product appearance and industrialization as main features. The Figure 5 represents the development of design and its role at Oilon Oy, from the beginning.

The introduction of design thinking approach to a strongly tech-oriented R&D cultures is not easy but certainly doable and beneficial for company’s growth, as many researches demonstrated. The McKinsey study (2018, 2) for example explored the business value of design by comparing companies that had all taken advantage of design and its processes. The study tracks different design practices in over 300 publicly listed companies in multiple countries and industries.

The results showed that there is a wide variation in the performance of the companies that make use of design practices. The companies that performed clearly better than others were the ones where design was part of the strategy and its process was utilized comprehensively. The profit of these companies increased by 32 percent and stock price development by 56 percent over the five-year follow-up period. McKinsey's study (2018, 14) identified the key actions that helped the best companies succeed and stand out from their competitors in a sustainable way. These actions were:

- design is part of top management which means that it has a customer-oriented strategy and adopts an analytical approach to design by measuring company's design performance with the same interest as it does with revenue and expenses
- soften internal boundaries (for example between physical products, services and digital interactions) allowing the user experience to be at the center of company's culture
- make design practices accessible to all, so to implement it in multi-skill teams for improving the user experience
- allow testing, iterating and learning incorporating the users since the beginning of the development

Studies have shown that design has an impact on the competitiveness and success of companies, especially when exploited at a strategic level. With this development work, the designer brought to the company the design thinking processes, involved the people on the use of it and its tools and showed in which forms the findings are usable, creating a practical understanding of its value and potentials.

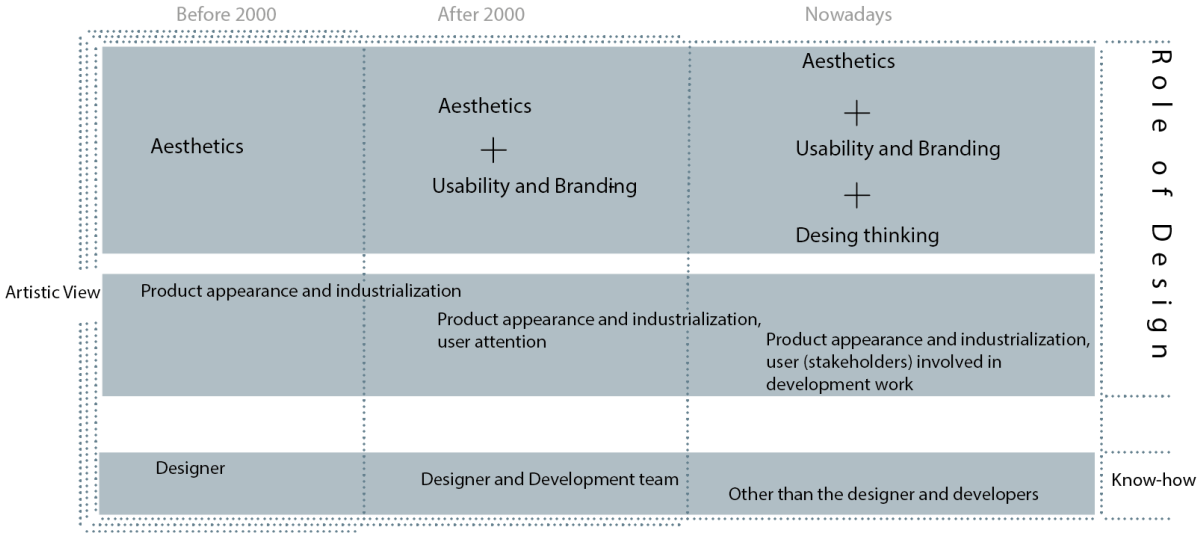

FIGURE 5. The changing role of design at Oilon (Danelon)

3.2 Design thinking

The foundation for design thinking was created in the sixties through the exploration of what design is all about, and how its processes and practices could be improved. At the beginning of the millennium, design thinking began to approach ideas of the front-end innovation, and the interest of companies in the subject has increased (Hassi et al. 2011a, 5). According to Curedale (2016, 19) design thinking is an approach that encourages the benefit of innovation and a wise change, it takes in consideration a broad human approach, and it is guided by creative and analytical thinking. Curedale (2016, 19) goes through a more vaster analysis of different ways of thinking that can be taken into consideration when approaching a development project. He refers to abductive thinking for a situation where the target is to explore what possibly can be true, starting from a not complete scene of observation, researching the balance from different conditions. Deductive thinking which imposes a more logical and specific solution starting from more know evidence, inductive reasoning that constructs the solution from explicit examples and critical thinking, which is a more rational and open-minded approach. Curedale (2016, 17-18) also considers divergent and convergent thinking; in the first thinking mode, the designer creates several choices, which are most probably quite alternative and addressed to the unknown and in the other mode, the convergent thinking, allows the brain to a more mechanical selection of the solution.

This development work applies both divergent and convergent thinking. When researching and ideating, the work generates plenty of ideas, so diverging towards the richness of opportunities; when organizing, extracting and filtering the key insights, converging towards a handful of encouraging ideas (Stickdorn et al. 2011, 85). Curedale (2016, 19) yet reminds that design thinking implicates a toolkit of methods that is available to cross-disciplinary groups or individuals.

According to Miettinen (2014, 11), design thinking is not only design activity but also the company's ability to be creative and proactive, adapt to change and provide tools for growing competitiveness. As Mattei (2019) said, design is complexity, diversity, in which people conceive a model, a set of approaches, a collection of processes to implement or think about transformation. These processes create the DNA, the identity, the codes that can then produce the diversity that is the condition for the creation of critical debate. The designer is the one who searches for the right questions, not just the one who finds reasonable solutions. For large companies, the fact of having a source of criticism inside in the organization is a way to protect themselves from the conformism and to be genuinely innovative. In Miettinen's opinion (2014, 11) design thinking enables a solution-focused approach that utilizes a multidisciplinary approach and taking advantage of a variety of methods. Design thinking allows customers' and stakeholders' participation in project development and together with other factors, like marketing and technology, allow projects to create the right value (Miettinen 2014, 12). Aminoff et al. (2014, 5) state that design thinking can be seen both, as a way of thinking and as a process that seeks to improve existing solutions and new user-oriented solutions by exploring different challenges and opportunities.

Considering the design solution-focused approach, the role of design comes very fruitful when operating in terms of innovation and corporate product development. Practically, Miettinen (2014, 14) briefs that the role of a designer and design is to form the working stage and provide methods and tools for a cross-disciplinary team of experts to implement in a new content and with new solutions. Design helps to solve things, qualitatively and meaningfully.

3.3 Process

There is not only one correct process model for design thinking. Brown (2009, 67) describes it with approaching the idea with divergent and convergent thinking. He describes divergent thinking by quoting Linus Pauling in his book Change by design: "to have an idea, you must first have a lot of ideas." It also counterbalances by using converge thinking, which, in return, refers to solution-finding among these various possible alternatives.

Design thinking means extensive mapping of options that are the result of a subsequent application of a combination of divergent and convergent processes, this together with the ability of selection and synthesis will move towards the desired goal (Hassi et al. 2011a, 7). Brown (2009, 66-67) sees this as a practical way to decide on existing things and a path to innovation. He considers the design process as a system of different states, rather than a series of defined and sequential steps. IDEO, where Brown is director, divides the design process into three stages (FIGURE 6). Inspiration, which identifies the problem and its potential, ideation during which various solutions are developed and tested, and implementation, during which ideas take the way to the market. (Brown, 2008, 88-89). These phases need to be repeated creating an iterative process until a satisfactory solution is found (Brown 2009, 16).

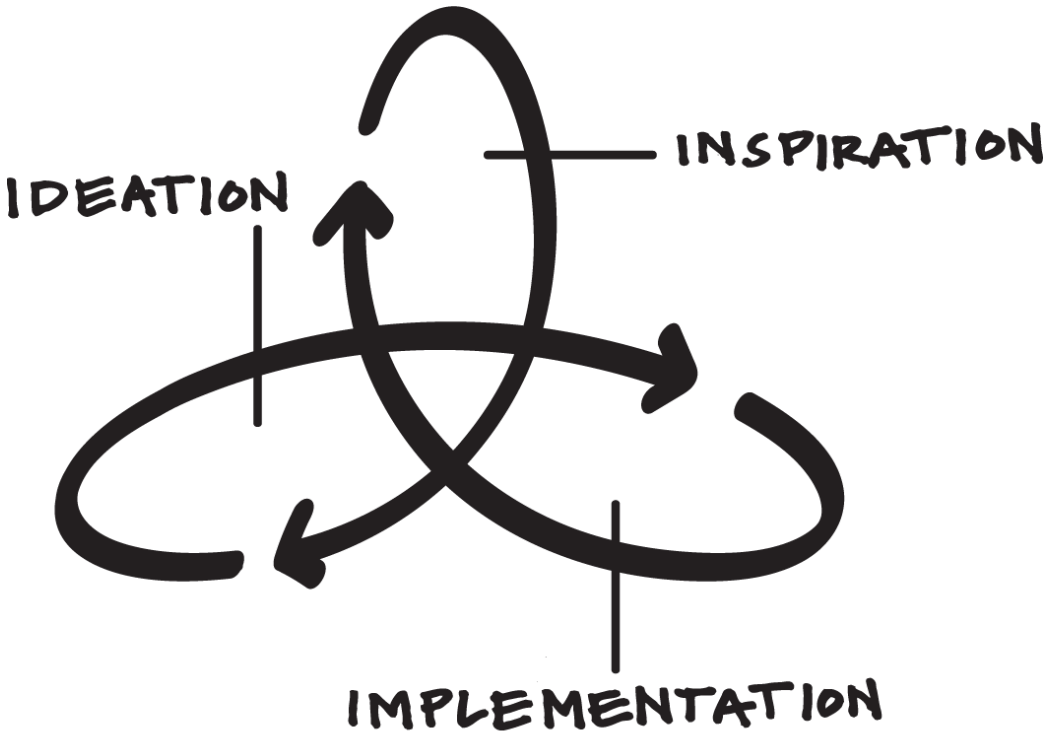

FIGURE 6. The 3 coreactivities of design thinking from IDEO.

Similar to the IDEO model but visualized with a more linear shape, is the Stanford D. School process, who sees the model in five stages (FIGURE 7). Starting with the first node, empathize, the designers are encouraged to see the process from the eye of the real users and to succeed in this, the interaction with them it is presupposed until a complete experience creation that leads to a more deep users experience. Once the empathy

findings are known, and they evolve into needs and insight, the process is in the phase where it is possible to define the problem. Here, the designers can point the challenges and create vision of what the design brief should be. With divergent thinking, designers are able to come up with a large quantity and broad diversity of solutions. The ideation phase gives radical design alternatives, pushed towards by positivity and avoiding evaluation during idea generations. Brainstorming methods leverage on the part of the brain that is predisposed to generate and at the same time, turn down the evaluative part. In any case, the convergent thinking will bring consciousness to evaluate and select from the most promising suggestions. The selected and evaluated ideas will drive the project components toward the prototype phase. The chance to interact with the model is critical, it allows the group to discover if the prototype can communicate the experience and empathy gained at the beginning of the process. The test is the possibility to refine, fix and decide whether achieved solution matches with the real needs (Doorley et al 2018, 1-15).

Like in IDEO, this process is not linear either, and all the stages are repeated, tested and experimented to find the deepest customer needs. In this way, Hasso-Plattner Institute, who works with Stanford D. School, sees that design thinking delivers practical solutions that can be anything, product or services, processes or procedures.

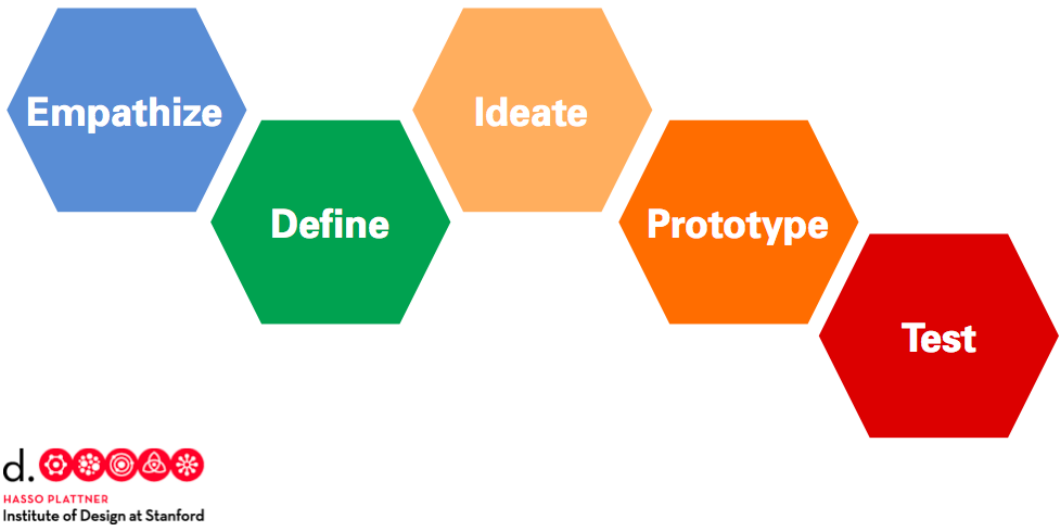

FIGURE 7. Stanford D. School Design thinking Process Hex Diagram model

3.4 Methods

The success of using the design thinking approach is the result of designer sensitivity and design methods applied to the combination of people's needs, technology and commercial strategy in search for a functional entity (IDEO 2019). The typical feature of design thinkers includes empathy for understanding the perspectives of different target groups. Design thinking emphasizes observation, collaboration, rapid learning by also being and doing with the various stakeholders of a project (Brown 2009, 87). The methodology that allows the design thinker to a holistic qualitative work also includes the ability to visualize, work with rapid prototyping and business analysis from different angles (Brown 2009, 86). According to Brown (2009, 100), the role of visuality is to make abstract things concrete so that the idea can be understood throughout the organization. Sketches, prototypes, storyboards or maps serve to keep up the communication between different stakeholders crystallizing the collected information (Brown 2008, 87).

As a method of user orientation and involvement, design thinking also uses co-design. There are many different explanations for the term, and other words like co-creation and participatory design have been developed alongside the word co-design as reports Stickdorn et al. (2011, 198-199) report. In co-design, people seek to be involved in the design project as equal and active participants with professional designers and other project partners. By participating in these groups, there is a broader range of ideas and development suggestions that could not be found without their involvement (Stickdorn et al. 2011, 192-193). As a starting point or values of Co-design trust, multidisciplinary, empathy and team building are necessary. The interaction between the participants is fundamental for the success of the workshop. The facilitator, or the leader of the group, has to take care of the process for creating a space where it is easy for everyone to speak and group dynamics remain equal. The facilitator needs to remain a part of the group, and not above it, although the facilitator's task is to take care of the process (Curedale 2016, 31-37). As Miettinen (2017, 138 - 140) points Rönnhölm's ideas that few rules can be followed to succeed as a facilitator in moving the ownership of the idea to the people involved and engage them for a significant motivation. Letting the people show their ideas, inviting them to the stage will allow them to feel more meaningful. Creating your prototypes and presenting them to the others make you believe even more on the potential in your hands. Granting the public a chance to navigate between more choices will allow realizing the options and making a choice personal. Finally, the facilitators should be able to create small challenges while the discussion is going on; this allows the participant to remain active and recognize the right problems and figure out precise solutions.

4 MAIN PHASES OF THE DESIGN THINKING PROCESS IN THE OILON IOT DEVELOPMENT WORK

4.1 Thesis objective, the design thinking process in use, the difference between methods and tools

The main objective of this development work was to create the foundation of the appropriate business model that feels logical, desired and competitive for the user. The development research done during this thesis allowed to shape and prove the interaction mechanism and factors that will support the new business and service creation around the Oilon IoT system. The project development group will make use of the profitable research findings in the future and concentrate on the service development, its prototyping, test and implementation.

This chapter, briefly explains what the development process main phases were, methods and tools used. The thesis will concentrate on the first three steps of the Stanford D. School process, as shown in the table (FIGURE 8), Emphatize, define and ideation. The material collected and analysed during this development work will be used after this thesis process, during the final two stages of the process, prototype and test.

In design thinking, there is a significant difference between tools and methods. As Stickdorn et al. (2018, 37) report, tools refers to what is in use, a concrete model in an Excel spreadsheet for instance that follow a specific structure or a template, and helps analyse a certain issue, methods are procedures to approach something in research content. Structured interviews is a methods and stakeholders' power-interest matrix is a tool, for example.

4.2 Understand the starting points of the development work

This development work began with understanding which was the direction to take for introducing the stakeholders in the project. The development challenge that the group have faced at the development's work beginning was: how to clarify the needs of the users in a complex IoT system that possibly affects the core business of the company. The design thinking tools allowed a systematic approach that offered an in-depth analysis of the stakeholders and their prioritization. Realizing to whom they were related to, permitted to understand how to interact with the different stakeholders.

4.3 Acquisition of empirical material

In the next step, the designer actualized the empiric data acquisition. The methodologies applied were qualitative interviews and co-ideation workshops. The designer decided to progress with both methods, because of the necessity to expand the services related to monoblock burners and the demand to add value to the relevant data monitored by the IoT system. The innovation workshops tool provided a possibility for a technical approach. Internal stakeholders participated in innovation workshops with the target of creating new ideas from a technical point of view. Structured interviews aimed at revealing the needs of customers and eventually their reaction on the implementation of IoT systems on monoblock burners. While the design thinking approaches produced their first findings, the project group has developed the first rough physical prototypes which were made for internal testing. System-oriented design with the Giga map tool, allowed detailed comprehension of the findings and flows of the interaction systems by extended graphical visualization.

4.4 Analysis of empirical material and opportunity creation meetings

All the empirical material acquired during structured interviews and innovation workshops was transcribed for further analysis. The transcription helps to organize and analyse all the insight discussed in detail during the sessions held with the stakeholders. The transcription also avoided any language gap between the facilitator and the workshop's participants and between interviewer and interviewed. The written material was filtered and clustered for further development with the project group. The findings from both design thinking tools and with the support of the Gigamaps allowed the production of a list of real opportunities that formed the basis for the new business models.

4.5 Definition of the findings for new business models creation

All the analyzed findings were crystalized and presented graphically on the Gigamap. The definition of the material allows the designer, after the thesis, to concentrate on the creation of a few different business models that are in line with Oilon strategy and today's trends. Additionally, at the end of the development work, evaluation and reflection were carried out on how the work succeeded in meeting the development challenges of the IoT project.

4.6 The phases and the Stanford D.School process

Understanding the development work, clarifying the stakeholders, how to approach them to find out their needs, talk to them and a have a good conversation, writing notes in the innovation workshops allowed the designer and the project group to **empathize** with the challenge to face. Analysing the empirical material from the interviews and innovation workshops and then elaborating the insights in co-design session allows starting to **define** the problem and beginning to have an overview of the possibilities. Gathering all the information achieved in the two first phases of the design process into the Gigamaps helps the designer to understand the complexity of the system, see the connection between systems and start to **ideate** the services around the new business models.

Phase	Step	Input	Work to be done **Content**	
	How top clarify the needs of the users	Analysis of the development approach	Methods and techniques evaluation	UNDERSTANDING DEVELOPMENT WORK STARTING POINT
Emphatize	Internal stakeholder analysis	Working group knowledge Oilon internal documentation	Internal stakeholder analysis Evaluation of the chosen stakeholders	IDENTIFY THE RIGHT USERS TO DESIGN FOR.
	Creation of the Gigamap	Information gained during meetings,-benchmarkig and stakeholders analysis	Basic elements, internal stakeholders, brand elements, culture, interactions Evaluation of the chosen stakeholders	
	External stakeholder analysis	Working group knowledge Oilon internal documentation	Brainstorm external stakeholder Cluster and link them	
	Rieview of the Giga map	Knowledge acquired Analyzed stakeholder network for each opportunity Technology developments Security, connection, hardware	Update the map and addition of the technology findings	
	Customer semi-structured interview creation	Selected stakeholders name list Contacts	Structured interviews creation Structured interviews - Questions analysis with the project group	
Ideate	Innovation Workshop with Internal stakeholder Group 1	Internal knowledge Generic product and service Ideas Project relevant questions for discussion CARDS with relevant information about burners data and IoT sensors	Write down post-it. Type of data to be collected Ideas sparring	ACQUISITION OF THE EMPIRICAL MATERIAL
	Innovation Workshop with Internal stakeholder Group 2	Internal knowledge Generic product and service Ideas Project relevant questions for discussion CARDS with relevant information about burners data and IoT sensors	Write down post-it. Type of data to be collected New ideas sparring	
Emphatize	Customer semi-structured interviewes	Selected stakeholders structured interviews Interviewed opinion and knowledge	Semi-structured interviews	
	Interviewes lettering and material analysis	Customer interviews	Cluster ideas in different ares for development Cluster opportunity	ANALYSIS OF EMPIRICAL MATERIAL AND OPPORTUNITY CREATION MEETINGS
	Opportunities ideas meetings	Innovation workshops ideas Challenge map Giga map	Open up opportunities from innovation workshops and structured interviews Explain and discuss ideas andd values	
Define	Review of the Giga map	Ideas list from opportunity idea meetings Findings from semi-structured interviews Technology, brand touchpoints,relations between findings	Update the map,create relations between components of the map, add brand touchpoints Stakeholders from analysis and theircontribute Value proposition for each stakeholder	FINDINGS ON THE GIGA MAP FOR NEW BUSINESS MODELS ANALYSIS
Ideate	Business model ideation	Giga map Business model canvas	Ideation of different business model canvases	WORK AFTER THESIS

FIGURE 8. Development process phases (Danelon)

5 WORK PLAN AND DESIGN THINKING METHODS EXPLAINED IN THE OILON IOT SYSTEM DEVELOPMENT

5.1 Gigamaps in System-oriented design

The nature of this project and one key point to succeed in it, was to discover the multitude of connection between the different systems that this development work faced up. Systems made of two or more parts interacting to function as a whole within some boundary. A system consists of parts, each of which can affect its behaviour or its properties. Each part of the system, when it affects the system, is dependent on its effect on some other part; in other words, the parts are interdependent. No part of a system or collection of parts of a system has an independent effect on it. A system as a whole cannot be divided into separate parts, even if it has significant implications. A system is not the sum of the behaviours of its parts, it is a product of their interactions. For instance, if a program of improvement that is directed at improving the parts taken separately, for sure the performance of the whole system will not be improved (Ackoff 2010). Bridging the different perspective of the system under discussion with the complexity of the real world, allowed to advance the debate and detect ruptures in the design process. In this holistic approach, the discussion sees the customer always in the centre, also considering gaps and variation between the network of stakeholders (Sevaldson 2015, 2).

Applying System-oriented design, the designer is looking beyond the object, trying to perceive the indication of what comes to the surface in different fields that are crossing each other (Sevaldson 2010,9). The designer that applies System-oriented design is more interested in looking for areas of relations and pattern of interaction instead of hierarchies and boundaries of the system. In this way, the designer's attention focus on systemic interventions, experiences and interaction (Sevaldson 2013,3).

The process starts with visualizing what comes out from meetings and project developments, creating maps of the insight and the concepts achieved. Visualization can be used as a design and communication tool, so the initial objective of the plans is making things look visible and understandable also for those that are not at the same stage in the project. In visualization, it is essential to support the development of intrinsic human models, and more generally to visualize the meaning of any information that is representative of human self-understanding. Visualizations create a spoken language for the design team for understanding and speeding up the development process (Tuulaniemi 2011, 50). As Stickdorn et al. (2018, 110) point out, visualizations helps teams uncover gaps in the data, bring structure into the complexity of it. As Sevaldson (2013,9) explains, Gigamapping

also helps its users in sharing overviews, synchronizing the same outline. It facilitates the team to point out and find opportunities and allowing stakeholders to a common and understandable setting for dialogue. In the project Gigamap is in constant evolution, enriched with the emerging information and development achievements.

While the project evolves, the separate maps evolve into Gigamap where findings can be reinterpreted with the elements of a complex system for a more holistic view. Black spots are magnified by the intervention of experts or research tools that allow the team to see more clearly important spots and poorly defined areas. The Gigamap is based on research on qualitative, quantitative information and expert knowledge, through numerous iterations and information quality checks that makes it as precise as possible (Sevaldson 2013,7).

Gigamaps at least, clearly have the characteristics to mix a different kind of information, from pictures to graphics, from text to other relevant media. In its process, it includes the analysis and creation of other types of maps, that combined all together represent the ecosystem complexity where we are working. It is a great mapping tool that goes through multiple layers with the target of searching the interconnection between the categories (Sevaldson 2012).

Sevaldson reports (2013,9) some of the proven benefits that his students achieved when using Gigamaps. The tool can be used in training programs for staff members and teaching compensating for the lack of knowledge, offering the whole landscape on a complex environment. Also, the detailed visualization created by shared content concedes the designer to dive into and find the ideas that become business models or potential innovations.

Sevaldson writes (2013, 13-14) that Gigamap needs a mind switch that permits the shift attention from object and entities to relation between them and taking in consideration businesses and organisations. These relations can be seen between technology, ergonomics, interactions, marketing, branding, competition and culture. These elements are brought to the surface by the tools from the design thinking. The mass of information that came from stakeholder analysis, structured interviews and co-designed workshops constructed a large and dense diagram. Designer with design skills generates that new information for the business models to come. Gigamaps are also very useful to figure out potential innovations (Sevaldson 2010,9).

5.2 Stakeholder identification and mapping

The literature presents different methods to investigate the stakeholder identity of a company. The designer chosed to proceed with a qualitative method which gives the possibility to open the discussion of who is receptive towards the project in case of new or hidden stakeholders emerge and also allows to begin to understand needs and hopes (Cadle et al. 2010, 25.) According to Cadle et al. (2010, 25) there are three main methods in use in the qualitative investigation. Interviewing and observing the personnel can be effective methods but the third one, the workshops, are more suitable in this case because it allows cooperative approaches to the development. Workshops also permit project team members to agree on the selection and direction chosen, identify and agree on the requirements and examine, review and approve some possible solutions to the requirements (Cadle et al. 2010, 30).

According to literature, the identification of stakeholders can be combined with multiple identification methods to ensure that all the stakeholders are considered (Cadle et al. 2010, 63-64). Stakeholder identification can combine a systematic review of stakeholders, background research, and the identification of stakeholders at the organizational level through methods like stakeholder wheel.

The stakeholder wheel (FIGURE 9) is likely to be used as a checklist that helps workshops participants to consider stakeholder groups (Cadle et al. 2010, 66). In consideration that external stakeholders are most probably the most difficult to identify, the wheel allows to set out the stakeholder groups in relation to Oilon’s activities. Cadle et al. (2010, 65), say that the wheel helps identify the range of the stakeholder groups and together with the previous background research, opens the discussion for the identification of new groups, both internal and external. This activity can be supported by brainstorming activity.

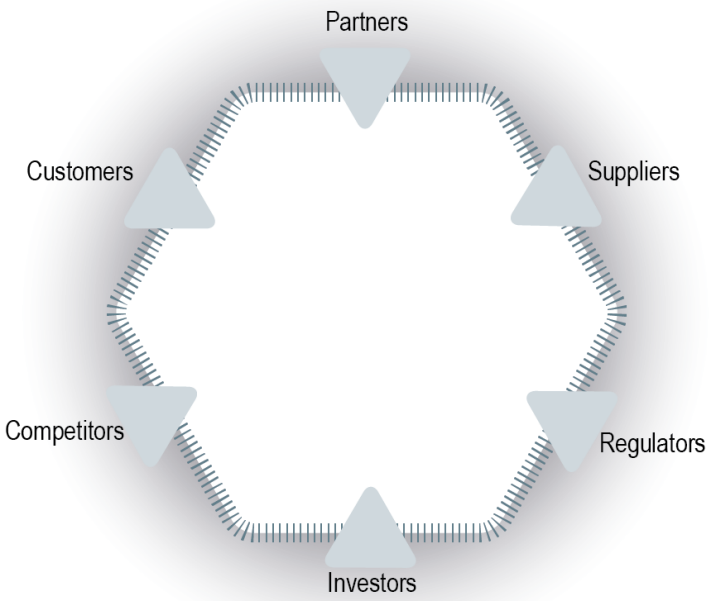

FIGURE 9. The stakeholder wheel (Cadle et al. 2010, 65) (Danelon)

5.2.1 Stakeholder priorization with power interest matrix

Identifying key stakeholder groups and prioritizing subgroups within stakeholders, is possible between the other methods using power-interest matrix (FIGURE 10). In the model, the horizontal axis describes the power of stakeholders and the vertical axis describes the interest of the stakeholder in the company. The matrix model is divided into four sections. Stakeholders with great power and interest in company activity are players and form a key stakeholder group. Meeting the expectations of the players is important for the success of the company. High interest but low power groups are called subjects. The mass includes stakeholders whose power and interest in the company is low. Context Setters are a great power for the company, but with little interest in its activities. It is advisable to find out the expectations of the latter stakeholders in background skills, as the group can, when activated, switch to a player section, the company's key stakeholder group (Johnson et al. 2008, 157.) As Cadle et al. (2010, 70) point out, Stakeholder positions in the matrix model may change as power and interest levels vary. Also, changes can occur as a result of in-house actions or may be caused by external factors. The matrix model helps to understand the impact of stakeholders on a company strategy and indicates how it can influence stakeholders. (Johnson et al. 2008, 156). The model classifies the interest and power of stakeholders from the perspective of the company, thus ignoring the stakeholders'

perspective. Businesses and stakeholders may have very different views on interest and power, which can lead to wrong conclusions and can make solutions challenging to implement. Stakeholders' opinions could be captured through their interviews. Bryson (2004, 11-12) explains that exploring the characteristics of stakeholders, and in particular, their expectations is important to get the best and most accurate picture of stakeholder views.

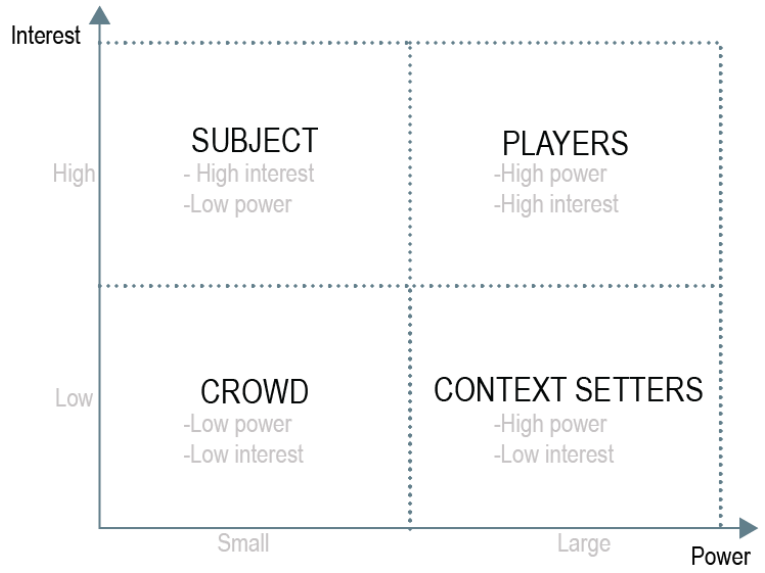

FIGURE 10. Power-Interest matrix (Bryson 2004) (Danelon)

The company should actively manage relationships with high power and interest stakeholders, the players. These stakeholders have to be involved in company projects, key decisions and their expertise should be used to the fullest extent possible. Players need to support and submit to company projects' work constantly. Nothing should come as a surprise to players through public information. Background activities should be monitored, and the group should be kept satisfied. Target stakeholders should be kept aware of how the company operates; communication about changes in the projects are vital for maintaining the interest from stakeholders (Cadle et al. 2010, pp. 69-70).

The matrix presented in Figure11 directly derived from the power-interest matrix with the addition of the interaction between the stakeholders and the project. In this way the power-interest matrix identifies the company's strategy in addition to key groups or individuals. This allows the working group to understand how to interact and manage the stakeholder group by understanding the level and the measures how to implement. (Cadle et al. 2010, 66-70).

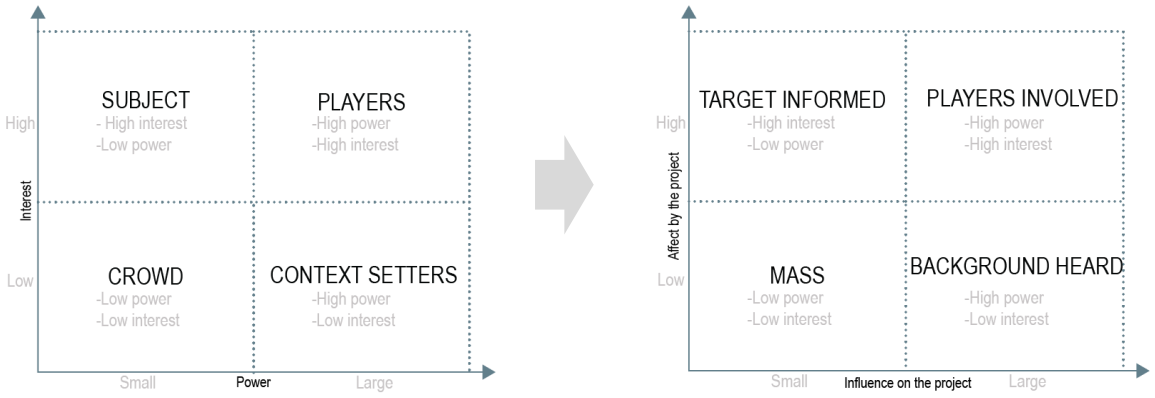

FIGURE 11. Interaction methods determined by the power-interest matrix Cadle et al. 2010, 69-70) (Danelon)

5.3 Customer interviewees and identification of development challenges

According to Ojasalo et al. (2015, 104-105), research methods used in development work are quantitative and qualitative. Qualitative methods are typically in use to explore topics that are not well known and want to be better understood. Qualitative research often aims at gathering diverse information and gaining a broad and holistic understanding of the subject. Interviewing is a method of data collection that provides quick access to in-depth knowledge and new perspectives on the topic (Ojasalo et al. 2015, 106). The interviews aim at getting information about users, customers or stakeholders, understanding their daily lives, environment, needs, attitudes, experiences, processes, emotions and expectations, values and views (Stickdorn et al. 2018, 122). Interviews can be conducted as a structured, semi-structured or open interview. The interview can take place as a conversation, or in an usage situation according to the interview frame. The goal is to find inspiration, a design guide, and to get an insight from the views of the interviewees (Tuulaniemi 2011).

The semi-structured interview seemed to best suit the purpose of this study. These kinds of interviews give the interviewer more room to move around and delve deeper into the topics that emerge during the interview than structured interviewed. The interviewer must take into account the interviewee's cultural and educational background and the impact of the interview site. In a semi-structured interview, questions are pre-prepared, but the interviewer may vary their order according to the course of the meeting. (Kananen 2008, 73-74). The exact wording of the questions may also vary, but in any case, based on its preliminary work, the interviewer makes an interview body that acts as the red thread of the

interview. Pre-formed but unsuitable questions may be left unanswered, and issues raised during the interview may be reconsidered accordingly (Ojasalo et al. 2015, 106).

Semi-structured approach seemed justified considering the peculiarity of the project for the company's main businesses, stakeholders from various culture and their low preparation on the subject. The designer came to the conclusion that semi-structured interviews are a valid method for gathering diverse and in-depth information from the selected stakeholders in this project.

5.4 Co-design – An active and multidisciplinary process

One of the main ideas of design thinking is the involvement of different parties for the development of a project. The end-users are the expert of their own life and own activities, and on the side of the provider of the service, all the company departments involved in the service have the critical task to understand the user needs. An essential mission of design thinking is to provide usable tools and methods for joint development for both users and other experts in group workshops. In the thesis, the definition of Co-design follows the broad model of Sanders (2012, 25), which sees co-design as a collaborative effort between a designer and unskilled individuals in a design development process. In this development work, all stakeholder representatives involved in the design process are experts in various fields, but they are not designers.

Co-design is an activity in which stakeholders work actively and socially throughout the process or part of a process to develop a service or product creatively (Aminoff et al. 2010, 7).The people involved in workshops must receive the means to express themselves, the means to strengthen their creative problem-solving capability, the ways to interact and co-operate. Co-design must give the methods of communication, which, in this case, means both visualization and sharing information with others involved in development. From this wide-ranging point of view, designers select the elements best suited to the objectives for further development of the concept. (Tuulaniemi 2011, 51).

The interaction between the participants is fundamental to the success of the workshop. The facilitator's job is to create a space where it is easy for everyone to speak and assure that the group dynamics remain equal is the facilitator's job. As Kantojärvi (2012, 11) writes, facilitation is a neutral control of the group process; give the co-design participants as much freedom as possible so they can feel and be the owners of the ideas generated. Kälviainen (2016, 1) also explains that in Co-design is useful to create collaboration that can help stakeholders understand their role throughout the process and their common goals. As Stickdorn et al. (2011, 400) explain, the facilitators can sometimes know that the

group is not in comfortable task or situation; still, they can remind that it is reasonable to be confused and yet help the group understanding where they are in the process.

The co-design development process characterizes from convergent and divergent stages (FIGURE 12), which reflect the adaptive and iterative nature of the design process that moves forward and adapts (Stickdorn et al. 2011, 90). As Kantojärvi (2012, 25) writes, divergence is opening, and convergence is closing. To complete both stages, a facilitator ensures that the group focuses on either divergence or convergence at a time. Some persons might be keener in criticism than others, and they must be reminded that the time for criticism will be when it is time for convergent discussions.

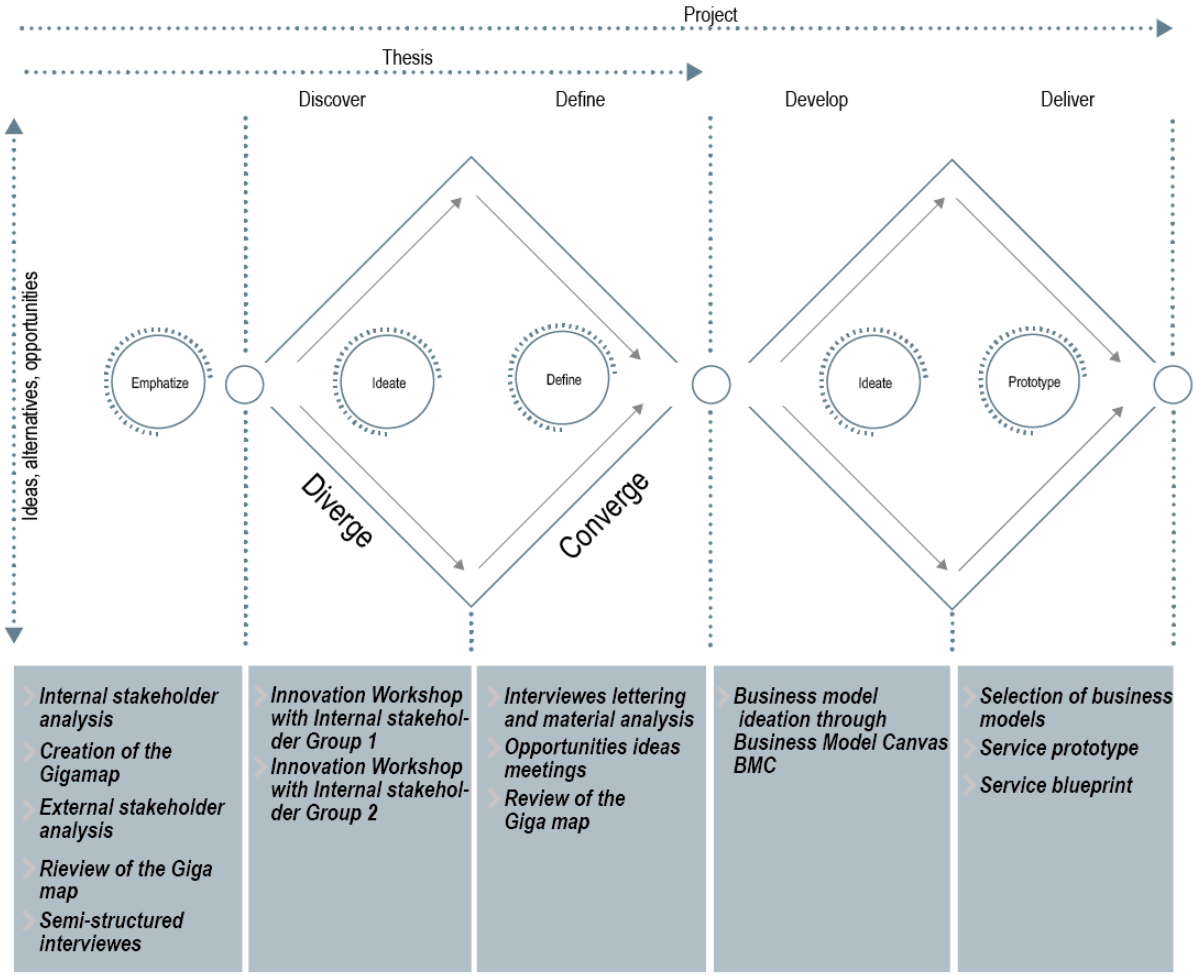

FIGURE 12. On the left side the thesis path with practical phases related to divergent and convergent thinking. The figure describes the whole project as double diamond process of two rounds of divergent and convergent thinking (Danelon)

Pre-organizing and planning the schedule, the venue, logistics and proper working facilities for the kind of work to be done, is vital for a successful workshop. Careful participants' selection makes the difference for a successful workshop. Participants have to be pre-informed about the content such as the focus and the goals of the workshop. Considering that the workshops' duration might vary, it is essential to recognise that participants might not be able to carry out one task for a long time when planning the workshops and also breaks need to be scheduled (Kälviäinen 2016, 3-4). Benefits of co-design activities are related to the engagement from all the participants of the process with the commitment to the same goal, which is often user-oriented. The advantage of allowing multidisciplinary development with different stakeholders enables creating a solution where different stakeholders jointly consider the risks (Kälviainen 2016, 12).

5.5 Business model canvas

The business model canvas is the starting point for a reasonable discussion on business model innovation. The tool (FIGURE 13) will be introduced after this development work when the project group has assimilated research findings. After the thesis, workshops sessions will be organized with the scope of ideating business models. The tool is visual, so it allows talking about complex phenomena in a clear and structured way. In the Business Model Canvas nine building blocks cover the main areas of business, customers, offer, infrastructure, and financial viability (Osterwalder et al. 2010, 15).

The Customer Segments section identifies the most critical customers or customer groups for which value is created or provided based on needs. Value Propositions is about what value the business creates for customers, and what generates it. Which customer problems can be solved, and what are the benefits it can provide. Which customer needs are under consideration, and what kind of product or combinations of products and services can be offered to each customer group.

The Channels component (marketing, sales, and distribution) identifies the current, best, and most cost-effective distribution channels to reach efficiently the customer, also the way to discuss, meet and interact with the customers. Customer Relationships answers questions about what kind of customer relationships a customer group expects from a company, how customer relationships are integrated and have consequences with other business models considering the offerings and their prices. Customer Relationships also take care of the discussion about how customer service is managed.

Revenue Streams is about pricing value proposition (products and services). It deals with how different customer groups are willing to pay and how much the different parts of the value chain are successfully generating from the overall result.

Key Resources identifies the most critical (physical, intangible, financial, and human) assets required by the previously mentioned canvas elements to deliver the value promise. Key Activities answers the questions of what the mandatory tasks are to deliver a value promise and what are the key activities. What has to be done to support the business model. Key Partners identify partners and suppliers that can leverage the operations of the business. Cost Structure describes the significant costs generated by a business model and it derives from key resources and core processes (Osterwalder et al. 2010, 20 - 41).

When planning a business perspective, the focus is first on the right side of BMC's value creation and the elements that are important to customers. Then comes the left side, which focuses on fulfilling the customer values. The value can be discovered by, for example interviewing real customers about their desires and needs. (Ojasalo et al. 2014, 185). Business Model Canvas can be drawn or printed on paper. Business modelling is initiated by reflecting on the dream situation from the corporate perspective, starting with logging from the customer groups of the company, going through nine areas, describing each ideal situation from the corporate standpoint (Ojasalo et al. 2014, 185).

Another potential way to use the canvas for own business purposes is to analyse the models of the competitors. After competitors' identification, their model may be constructed for each of them individually. By observing a competitor's behaviour, experimenting with their products, and interviewing their customers, one can deepen the design of the analysed model. In order to develop own business model, the different Business Model Canvases resulting from the process are compared to each other, picking out the best pieces and the sections needed for the missing parts of the ideas. The end result is the Business Model Canvas that combines the best elements in a new way. Ojasalo et al. (2014, 185).

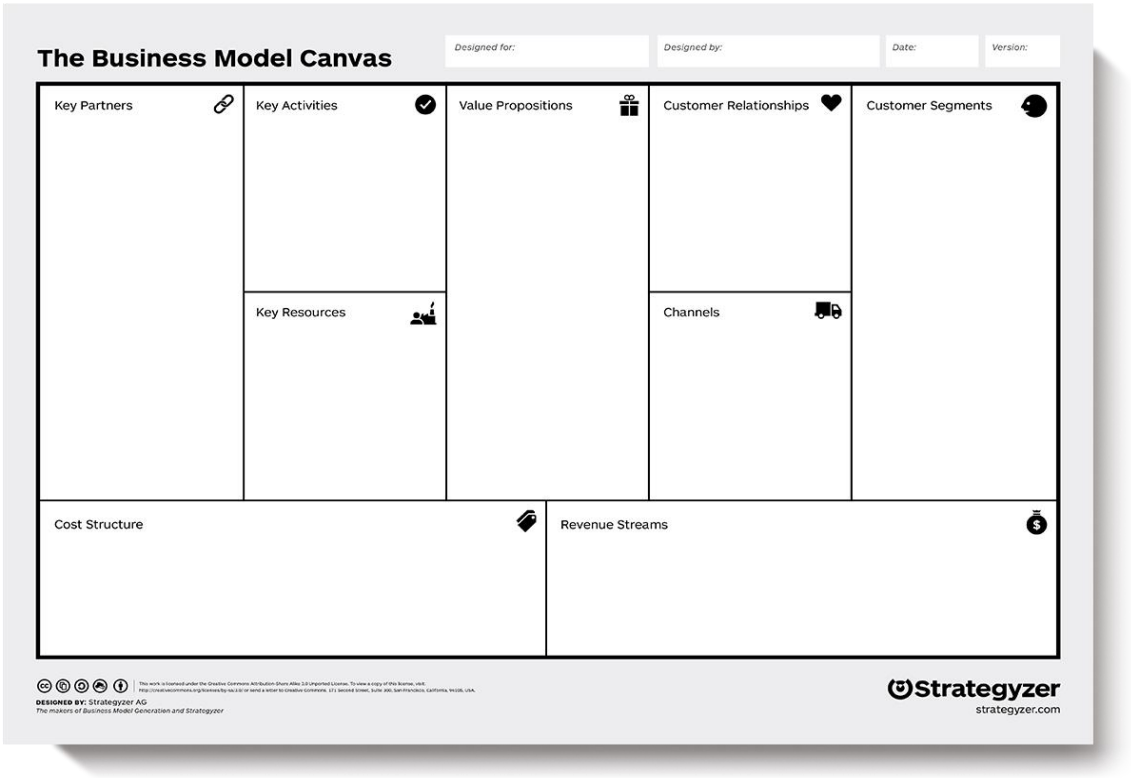

FIGURE 13. Business model canvas template (Medium 2016)

The ideation of multiple business model canvases allows the project group to play and be fruitful, creating as many models as the group can come up with. As Osterwalder reminds at Talks at Google (Osterwalder 2011), while ideating new business models, it is suggested to go quite roughly through the canvas, sketch the first one without going too deep into details and move to the second canvas, and this time, heading to a completely different direction. Repeatedly, rough sketch of the business model through another one. Again we are diverging toward a mass of ideas to achieve a profitable situation where the group can finally choose from a plentiful amount of ideas and converge in the direction of the most excellent service. Often, during the model creation, it is easy to fall in love with the first business model that comes up. Also spending too much time on the first one or going too deep too quickly with one specific business model is not a powerful mechanism to get business models. (Osterwalder 2011).

6 ACQUISITION AND ANALYSIS OF THE EMPIRICAL MATERIAL THROUGH STAKEHOLDER ANALYSIS, SEMI-STRUCTURED INTERVIEWS AND CO-DESIGN METHODS

6.1 Stakeholder analysis

In Oilon IoT system project, the stakeholder analysis took place with the project members and some of the department leaders. The work was divided into two workshops, considering the need for the designer to assist the workshops' attendees and so to achieve better results. Also, the amount of work to be done per each group was enough for the participants' optimal concentration level. First, the focus was on the internal stakeholders and then on the external ones. Internal stakeholders are entities within a business, for instance, employees, managers, the board of directors and investors. External stakeholders are entities not within a company itself but who care about or are affected by its performance, for instance, consumers, regulators, investors and suppliers (Cadle et al. 2010, 66). The starting point of the discussion in the first workshop was Oilon's organization chart, which is continuously updated and shows clearly the internal stakeholders' names and positions in the company. As Caddle et al. (2010, 66) report, external stakeholders are usually more challenging to identify, so analysis workshop benefitted from the stakeholder wheel tool to support the discussion and visualize the outcomes. The Figure 14 presents the group work participants for stakeholder analysis.

The findings of the stakeholder analysis were fundamental for the subsequent stages of this development work allowing the designer to decide which stakeholders to invite to the innovation workshops and to ask to participate to the semi-structured interviews.

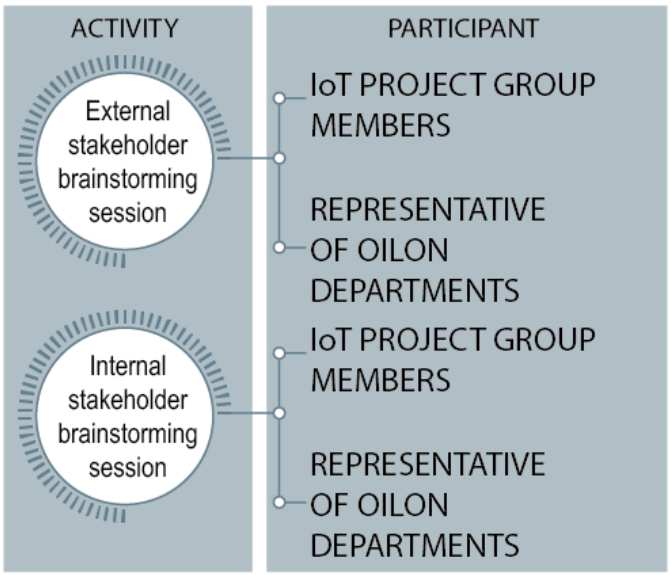

FIGURE 14. Group work participants per each stakeholder analysis activity (Danelon)

6.1.1 Internal stakeholder analysis

The Power of Interest matrix model was used to prioritize company's key internal stakeholders related to the project. Internal stakeholder nomination was carried out by discussing in the workshop with department leaders. In the matrixes of the figure 16 the stakeholders are marked with a letter to separate them. The vertical axe describes the stakeholder's level of interest of the company shown as the interaction type and the horizontal axis demonstrates power and it influences the project. The mapping system defined the stakeholder contribution and its counterpart on a scale of 1-4 (4 = very important, 3 = important, 2 = minor, 1 = not significant) from the perspective of the target company. The designer, together with the project manager elaborated the tool visible as an example in Annex 1. The process of recognizing key stakeholders and the definition of their contribution to the project was very systematic. In the internal Oilon organization chart there were eighteen stakeholders listed, and all were discussed during the meeting. The evaluation of each stakeholder happened by starting with answering the question reported on the Excel file, each question was asked to figure out relation with the project of each stakeholder. As mentioned previously, values from one to four were assigned together with a note about the reason for the value. Totally, in the tool, there were eight questions, six that help understand the stakeholder's influence on the project and two to reveal whether the stakeholder is affected by the result of the project. The average of the values given were calculated in the excel table and then graphically represent in the chart (FIGURE 16).

	LOGISTICS		R&D				
Stakeholder Name	WAREHOUSE	PURCHASING	STANDARD BURNERS	RESEARCH and LAB TESTING	PROJECT BURNERS	CONTENT MANAGEMENT	HR
MARK FOR MAPPING	A	B	C	D	E	F	G
Questions for opening internal stakeholders analysis discussion.							
Influence on the project?	1,0	1,2	3,2	3,8	3,2	3,0	1,0
Does it have the expertise in the field?	1	1	4	4	4	3	1
Does it have important information about the technology?	1	1	4	4	4	4	1
Could it support the project plan?	1	2	4	4	4	3	1
Is it responsible for the plans of the project?	1	1	3	4	3	3	1
Does it controls the implementation tools?	1	1	3	3	3	3	1
Does it have the power to end the resources?	1	1	1	4	1	2	1
Affected by the project result?	1,0	1,5	4,0	4,0	3,0	3,0	1,0
Does it get benefit from the project?	1	1	4	4	3	3	1
Is interested in the result of the matter?	1	2	3	4	3	3	1
Key stakeholders - Total	2,0	2,7	7,2	7,8	6,2	6,0	2,0

FIGURE 15. Stakeholder analysis tool with questions about the stakeholder relation (Danelon)

Based on the matrix figure 16, the result to keep the key stakeholders actively involved in the project groups of the company were: Research and Lab testing, the development department of standard burners and project burners, the sales department, the commissioning and content department. The table shows that the importance of other groups, the owners of the company, the management, and the spare parts sales resulted in being kept informed about the development of the project.

The IT department ended up being the only one located in the area of the matrix of the background heard, which have high influence on the project but might not being directly affected by its result.

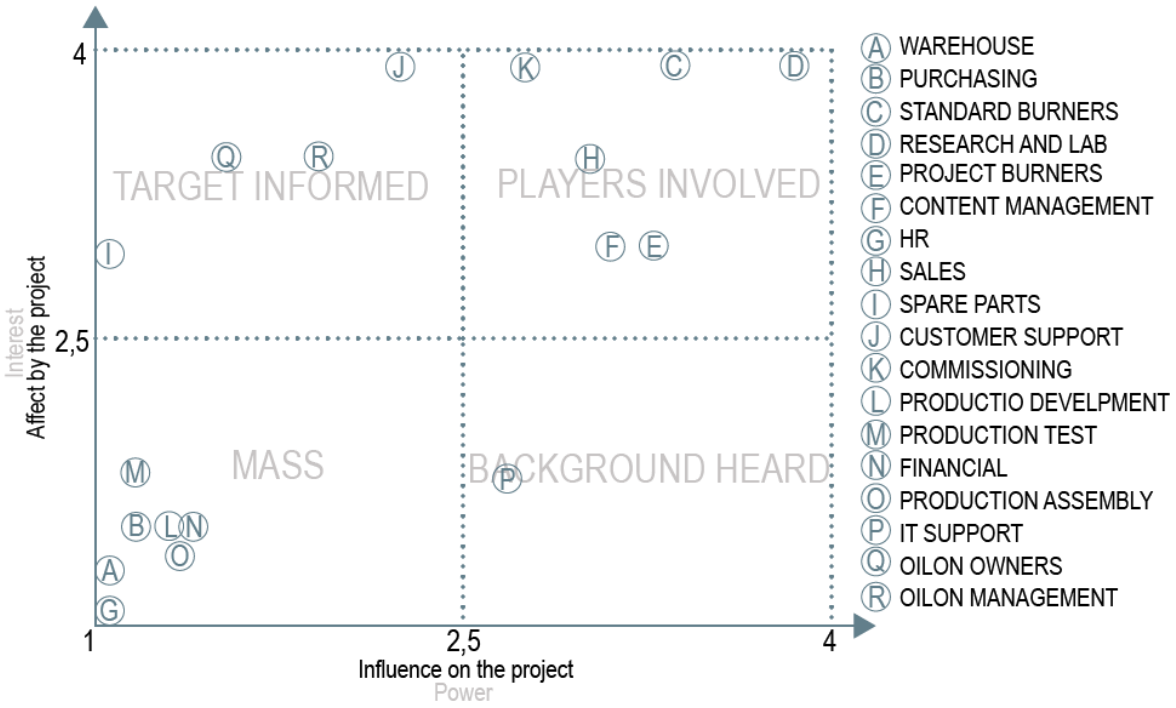

FIGURE 16. Power-interest matrix related to the project (Danelon)

6.1.2 External stakeholder analysis

The workshop participants name list was created by mapping internal stakeholders and the list of persons from Oilon who would have significant knowledge about the possible external stakeholder relations to the project. The prevalence of the workshops' attendees was, in any case, project group members and representatives of the sales department.

As previously mentioned, Caddle et al. (2010, 66) suggest the use of the stakeholder wheel as a checklist, so when the discussion takes place, all of the key stakeholder groups are included. The designer, in charge of the workshop's facilitation, proposed brainstorming as a discovery technique considering that all the participants of the meeting knew each other and their status did not present significant differences that would have mined the discussion (Cadle et al. 2010,35). However, taking in consideration the general structure of a meeting in the company and the low confidence of the group to work in this kind of workshop environment, the facilitator allowed some practical modification to the typical actions during brainstorming practice..

The stakeholder analysis was organized just a few months after the IoT project started. Few project meetings and related decisions had already happened, so the project group has already defined with project targets, technical specifics and part of the stakeholders.

None of the stakeholders was yet definitely chosen, but the path that was to be initiated was somehow visible.

The actual brainstorming session started analyzing the external stakeholders starting from the partners to move naturally forward through customers, competitors, investors, regulators and suppliers. The facilitator's role was not to interfere with the decisions made nor to push the discussion towards any personal vision. The group was provided with written cards with all the stakeholders' names that were visible during the previous meetings. The designer's goal was to give as much space as possible to the participants for maintaining the discussion vivid and interesting and not to risk any failure. The cards stimulated the discussion producing a positive feeling and understanding of the work to be done, a spark that ignited the debate.

The facilitator, among other duties, has to be aware that the workshop documentation is produced. Valuable insight might be lost during a vivid discussion if not promptly reported including all ideas that might provide possibilities to the solutions. Brainstorming and the use of post-it documentation are not frequently used techniques at Oilon, and mastering their use takes time and practise.

A printed version of the stakeholder wheel was attached on the whiteboard, well visible and together with stakeholder cards. The discussion happened to be very clear and straightforward, having the designer writing the stakeholders' names on the post-its and trying to maintain to discussion clear.

The analysis about competitors, investors, regulators and suppliers opened up to interesting questions that allowed the project group to a wider spectrum of opportunities. New possibilities rised, for cross-disciplinary work with specialists of the sector that would increase the knowledge of the project group about IoT world. The group faced the discussion with enthusiasm reporting names and projects' examples that could possibly be useful in this particular project. In any case, as the literature reports, stakeholder analysis should be carried out at different times during the project because stakeholders could move from the previous position to another. New ones could come alone and become more prominent (Cadle et al. 2010, 70).

Customers were the easiest to find, considering the excellent relationships that Oilon has with this stakeholder's group. The name list came up very quickly, also adding to the designer knowledge the spectrum of different market segments represented by the chosen customer companies. The discussed customer company selection included boiler producers, dealers, power plant producers/owners and burner users, from different market areas and turnover.

A selection of about ten to twelve representatives of the external stakeholder was the fixed target to achieve a fruitful work during the interviews.

6.2 Semi-structured interviews

In qualitative research, the right amount of contacts to be interviewed cannot be determined in advance. Even if a phenomenon can contain many different points of observation, the research can be considered complete when the answers begin to repeat themselves (Kananen 2013, 112). As the stakeholder analysis was conducted, the designer with the project group decided to proceed with contacting two of the internal stakeholders, and nine of the external key stakeholders. Respondents of the interviews were selected from all the Oilon's primary market areas, Finland, China, US and Russia. The plan was to move on with the two internal stakeholders first and then the external ones. This decision was made first for the possibility to get valuable insight from relevant internal stakeholders that did not previously participate in the project; second, for the opportunity for the interviewer itself to train and test the structure of the interview. Figure 17 describes the work phases to get external stakeholder knowledge into the process development.

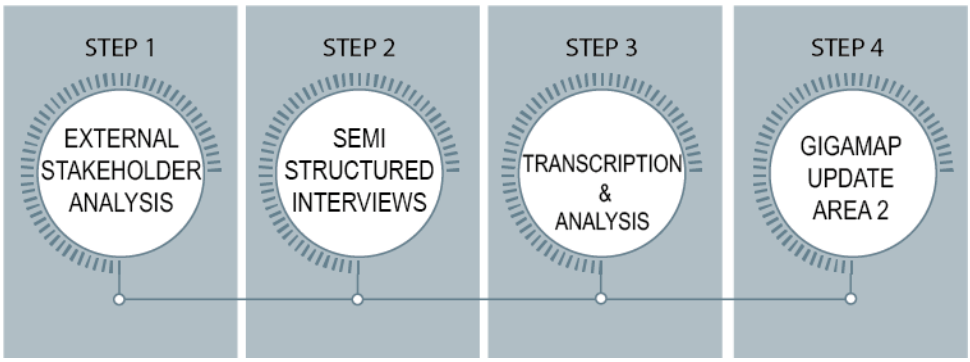

FIGURE 17. Empirical work phases with external stakeholder participation (Danelon)

What commanded the selection of the external stakeholder was the geographic location, the receptivity of the company in collaborating during development cases and the company's turnover related to monoblock burners sales. In the stakeholders' selection criteria, the designer wanted to be sure about the presence of real users of standard burners, someone that would have the hands on the burners and the data that come out from it.

In constructing the structure of the interview, the designer took into consideration that the public to be interviewed could have very different knowledge about IoT systems. In an interview environment, the lack of knowledge about the issue from the respondent could

result in an uncomfortable situation, spoiling the opportunity to get valuable information. This undesired situation can be accentuated in a different culture. For this reason, the structure of the interview allowed two different paths, one in case the respondent did not have any knowledge about IoT solutions and one where the conversation started with a more technical approach (Appendix 2 - 3). In both cases, the designer approached the subject with a simplified version of the Giga map (FIGURE 2). The graphic support allows a direct and clear approach to the topic uncovering existing gaps in the communication.

Semi-structured interviews were conducted both face to face and by Skype. The first mentioned, direct type of communication permitted to achieve a better interaction between the interviewer and interviewee. Meetings were conducted at Oilon Oy in Lahti, and outside the company. In these cases, the interviews were conducted mainly at the customers' premises.

In both interview structures, tools usually in use in a co-design environment were included with the purpose to search for elements of diversity during the conversation. The designer created element boards (Appendix 4). Their function was to bring the interviewed to spar ideas together with the interviewer or as a response of examples that were present on the element board.

With the counterpart's consent, the interviews were all recorded, allowing the researcher to reflect the interview material on his own and to continue the conversation moving deeper into the phenomenon under discussion. Subsequently, the material recorded was transcribed for further analysis. Semi-structured interviews allowed very fruitful work. Discussions with all the stakeholders varied from one to one and a half hour and the flexible structure to move around the questions allowed excellent participation from the respondent.

During this development work, in the middle of the interview period, the first news about Coronavirus in China started to spread. The importance of the Chinese market for the company relates to the significance of Chinese customer opinions, needs and feedback about the project. The critical situation commanded to decide not to approach the selected Chinese stakeholders to allow them to concentrate on their priorities. It is important to consider their involvement during some future phase of the development. The structure of this thesis and the adaptability of the methods in use allow to bring in new stakeholders also in an advanced stage of the service development.

6.3 Innovation workshops

Innovation workshops were ideated with the objective to create a more technical output that, together with customer needs, would be the basis of further service development. The aim was to set up workshops where internal stakeholders could confront their ideas on the matters that were fundamental for the value creation on the IoT system. Co-design processes allow a cross-disciplinary work that succeeds when boundaries are flexible, and silos are broken down including in the discussion of different group of stakeholders from across all the disciplines and groups related to the subject under development (Kälviäinen 2018, 2). The participants for innovation workshops are presented in figure 18.

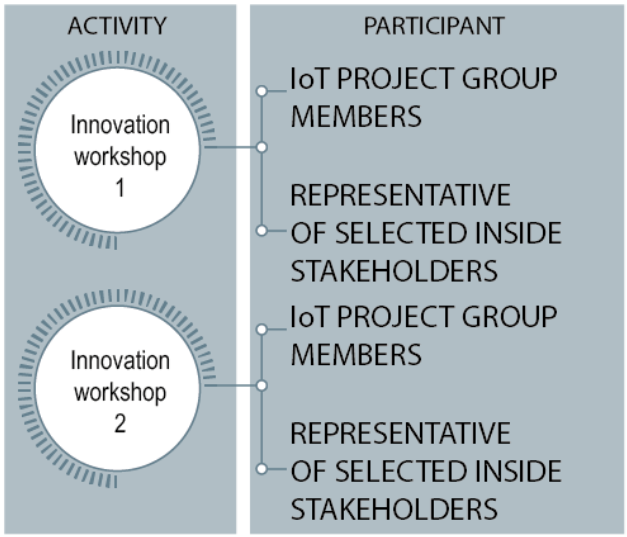

FIGURE 18. Group work participants per each innovation workshop (Danelon)

As Stickdorn et al. (2018, 408) suggest, the workshop area or room is a tool, the atmosphere created in it, must allow creativity. A conference room or an area can temporarily be transformed into a flexible and stimulating space. For this reason, the designer decided to use an unusual location for the meetings that would allow participants to be in a less formal situation. The area chosen was located at the Oilon manufacturing facilities in Lahti, right where monoblock burners are produced. The designer organised it, did not use chairs and arranged enough room for participants to move around and interact with others. Even though the room was in the middle of a production site, the removable walls provided confidentiality to the working group. The figure 19 presents the work phases to get internal stakeholder knowledge into the process development.

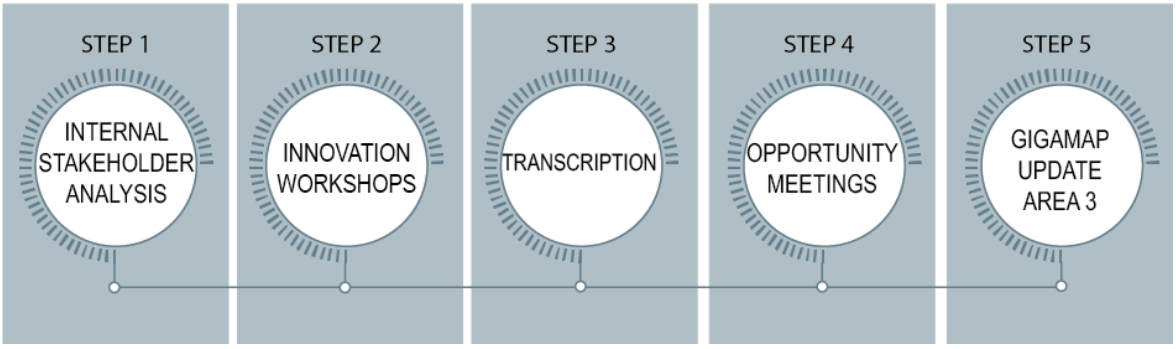

FIGURE 19. Empirical work phases with internal stakeholder participation (Danelon)

The innovation workshops type of work differs quite a lot from the typical work meetings that the project group and generally Oilon employees are used to. The need to search for the valuable out of the box idea, while discussing properties and features of monoblock burners, pushed the designer on evaluating the right working tools. Participants had been working together with the same methods and in the same developing environment for many years, creating strong habits difficult to change.

Even if internal stakeholders analysis' results were taken into consideration, the first issue to face for the workshops' organizer was whom to invite. Important was also how to group the participants to have groups of people where everyone would have to represent different areas of knowledge about monoblock burners. Each group was combined from a representative of the Research and Lab testing department, the development department of standard burners and project burners, the sales department and the commissioning and content department. Subsequently, the selection of the persons invited took into account their usual willingness to discuss and the ability to put themself in a challenging situation. Six people were asked for each innovation workshop session, so this amounted to a total of twelve participants. The amount of six participants in each session, allowed the designer, who was in charge of facilitating the workshops to keep the conversation pace up in case of need. He also helped to keep the discussion's focus on the right track and made sure that the conversation included everyone's ideas.

Co-design methods are very useful and very profitable if properly designed, used and facilitated (Stickdorn et al.,396 – 400). The designer during the thesis development has put quite a significant effort on creating a working situation that could feel fruitful, to the participants of the workshops and to the project group.

The necessity to create an optimal working space and situation grant a major interest from the participants (Stickdorn et al. ,396 - 400). To succeed in this, the designer took care not

only about tools and working area but planned the schedule according to the working tool designed, allowing enough time for working, but keeping tight to the schedule. The time management is important, but still, the designer steered the participants towards the goals if necessary, even if it took longer time than anticipated.

Facilitation starts allowing everybody present to understand what the purpose of the entire project is, but mostly what is the purpose of their presence in the workshop. (Kantojärvi 2012, 40). Considering that almost all of the participants were not familiar with the project insights neither with IoT systems, the designer introduced the project with a presentation. A presentation of a few slides incorporated the project goal and IoT basics and gave the participants understanding about the work to be done. Two hours per group were booked for the workshops, in which the designer fitted the presentation of the project of about ten minutes, the presentation of the working tool and the effective group work. Both meetings were recorded with an agreement with all the participants; this allowed the facilitator to active participation during the workshops and well documented material for further analysis.

The question pattern tool (Appendix 5) proposed six questions for each group. Considering the specialisation area of the stakeholders invited and the topics to be developed the question pattern had been created after a quite intensive analysis with the project group. Some of the questions speculated on issues that have to be explained with the proper terminology and specific technical point of view. As previously mentioned, the target of the workshop was to diverge, to get a relevant number of new ideas and possibilities.

Each of the six main questions presented on the tool were supported by other questions that helped the participants to get closer to a real example, get inspiration to start the discussion. The supporting questions also served to think about something not related to monoblock burners, to move the participants' minds outside the ordinary thoughts. The use of the support questions also helped the facilitator to keep on track; otherwise handled, it would have been challenging to introduce the questions to the group during the discussion. The A3 question pattern tool, gave the participants the right to read the question pattern and formulate ideas and examples that fed the discussion.

The tool also presented a second area whose function was to invite the group to analyse, to converge, right away towards the best idea. The designer thought that it could speed up the process of first ideating and almost right away evaluating the outcomes with the same group. The method did not work, neither there was time enough, nor the group was able to do such work.

The question pattern tool was designed to be used with post-its, allowing everybody to add their simple or less simple thoughts by writing them on the post-its. Considering the peculiarity of the working material, at the beginning of both innovation workshops, the designer introduced the question pattern tool and how to use it with post-its and markers. On the first discussion round, most of the participants started writing down the ideas but as soon as the debate got enthusiastic, writing notes moved to a second level. Even if the discussion was recorded, the designer wrote down all the notes on post-its believing in the potential of seeing the results that allowed the discussion to be genuine and constructive.

The questions of the tool for the first group were related with:

- Device condition for better process safety
- Burner process and its performance
- Real - time information and smart indicators

Together with the question pattern, the groups were provided with monoblock value card (Appendix 6). The cards presented lists of values and characteristics about monoblock burners, boilers and the environment where they are in use. The intent of the designer was to provide the groups material to start with, in case the discussion would fade away. It was nothing specific, just general information that could rise up the interest again.

The questions of the tool for the second group were related to:

- Proper data analysis provides real-time information
- Better burner and process performance
- Reporting tools such as advanced statistics and reports

The supporting questions presented in each question pattern tool defined the scope of each question and got the reader to connect to real situations that the user might face. Bringing examples from the field and also from outside burners technology's production helped the participants understand that there were no limits; everything could be proposed to achieve an exceptional result in comparison with an ordinary meeting.

The innovation workshops ended both with a remarkable amount of ideas and suggestions on how to make innovatively use of burning process values. The insight of the discussion was recorded and written on the notes, ready for further analysis and development.

6.4 Analysis of the empirical material

As Kananen (2008, 58) explains, the empirical material collected during the research phase can be treated with different methods. Data analysis is a time consuming, especially if there is plenty of textual content. This step can be performed with the help of a computer application that facilitates the organization of pieces of information and the search for the needle in the haystack. The designer had recorded all the meetings with external stakeholders when semi-structured interviews took place and also during innovation workshops. This technique enables a more precise analysis afterwards and shatters eventual communication problems during the meetings. The material recorded was reported and written down in Excel, which allows making division very easily by concepts, ideas and needs.

6.4.1 Transcribing

Transcribing means converting the recordings, videos or picture based materials into written form so that they can be processed for further analysis (Kananen 2013, 120). The recorded material of the semi-structured interviews and the content of the innovation workshops was transcribed into a form that could be easily understood for the analysis to come. First, the text produced was segmented for each context of the discussion, basically the subject area of the workshops and then classified for a more direct interpretation.

The material recorder produced a vast amount of text and insight. The innovation workshops discussions were transcribed into an Excel file and that file originated subsequently the tool used in the opportunity idea meetings. The Excel file presented the list of values and ideas in the first column, then observations, offering a systematic way of working to the working group afterwards. The opportunity idea meetings saw the participation of selected components of internal stakeholders considering that their technical expertise could help to open up and individuate the innovation from the mass.

The transcription of the semi-structured interviews was quite detailed; all the text expressed by the interviewees was reported, both in English and in Finnish. As Ojasalo et al. (2019, 119) remind, the material collected is not the solution to the development task but the material on which the development work is based. Reduction or combination of observations enable generalization of data with the meaning to combine individual findings with broader classes or groups. This work was done by the designer.

Semi-structured interviews' findings and reduction from the mass of value and ideas of the innovation workshops are part of the elements of the interactive system of information

present on the Gigamap. The designer in this development work worked to make sense of the systems' structures which will offer services to Oilon's customers and at the same time, provide valuable information to Oilon's employees. The map shows the complexity of the IoT systems.The findings of this development work are assembled by the designer to provide the project group with a detailed understanding of what are the information sources, the flows and the interaction that are important in the Oilon IoT system.

6.4.2 Opportunity idea meeting

Innovation workshops purpose was to diverge, to create the mass of ideas, to elaborate discussion that could open a debate with a spectrum of innovative options. In innovation workshop, the designer did not place any barriers; he fed the conversation with more questions that allow the group to catch the wind of the innovation. Opportunity idea meeting instead, looked for the details and searched for the possibility for realization. It practically converged from a mass to a selection of the best solutions, bringing along the feasibility approach.

Different stakeholders' participated in different ways. Some had joined the innovation workshops, but some others had not. Having an inhomogeneous group of persons, permitted a first test for the ideas proposed during the innovation workshops. The first reaction of the participants would have shown whether or not the idea would have been unthinkable or would present already some hope for the value researched. Everybody in the opportunity idea meeting had to face at list of few completely new ideas to analyse for value creation. The figure 20 presents the group work participants for the opportunity idea meeting.

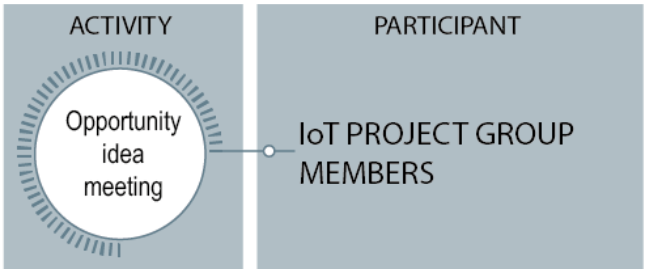

FIGURE 20. Opportunity idea meeting participants (Danelon)

The tool presented to the working group was inspired by Challenge mapping technique which is used for clarification of challenges. The challenge in this situation was to under-

stand whether the ideas are doable and create tangible value for the IoT System. The method, in the original version, sees the need to generate as many questions as possible, so to be able to define the understanding of a problem, influential factors and potential obstacles (Kantojärvi 2012, 98). The designer, for practical reasons, developed the material transcribed from the innovation workshops into a more detailed Excel sheet where ideas could be discussed by the working group (Appendix 7).

The sheet presented the idea itself, the reasons the idea was discussed during the innovation workshops, and following the challenging map rules that Kantojärvi (2012, 96) suggested, the barriers that the concept could face together with questions that could open up the problems, factors and obstacles. The working group, once it had reviewed the tool, enriched it with the interaction field that allowed to deal with all the other ideas and figure out what value or insight would have affected different values or insights present on the tool. Visualising this connection provided the creation of a precise scenario for a matrix of values. In the tool, values were also examined with a technical approach to evaluate their feasibility on hardware and software level.

The tool has presented a very systematic type of work, allowing the analysis of all the ideas and values that came up during the innovation workshop. It permitted to mirror ideas that were fluctuating because of their realization uncertainty with facts like hardware, sensor, software development and prices. The tool translated the indefinite of the innovation workshop to something tangible and presentable to the project group.

The material discussed was condensed and grouped into four main areas. The first agglomerate the **values that should be visible in the user interface** of the Oilon IoT System, the second assembly the ideas and values regarding the **problems, performance issues, and variables that affect and activate alarms**. The third brought together the ideas about developments of r**eporting tools and how the customer should be reached**. The last one evidenced the need for specifics service requirements within **commissioning, testing, and burner pre-settings**.

The result of this meetings which are the ideas and values demonstrated to be needed for the creation of the value in the Oilon IoT. They were inserted in the Gigamap and are not listed on this thesis to maintain the confidentiality before any prototype will be under test and any business model developed.

6.5 Analysis and interpretation of data from semi-structured interviews

The analysis of the semi-structured interviews has brought interest points to the developers' eyes. From a very different situations, comments came from deep knowledge about IoT systems and value inherent from its use at the widest of its meanings.

The participants of the semi-structured interviews showed a very different knowledge about IoT systems. Discussions took shape from simple references to everyday life achievements, through mobile apps that connect with home devices, to a particular explanation of what we can call Internet of things nowadays. In some cases, customers also showed proudly the history of IoT systems telling about their first primordial versions in the early decades of this millennium. This allowed the designer to understand what was the foresight of the person interviewed suggesting to go deeper or less in the following questions. All of the interviewees were familiar with IoT systems and agreed that implementing it on monoblock burners would be an obliged step on monoblock burner technology development. Interviewees saw very different possibilities for upgrading monoblock burners, and this was due to their experience on IoT systems. Because of this, answers open up ideas and values of different significance.

The relevance of data collection and the importance of its utilization was compared to the reaction of the customers considering different cultures and security issues related, for instance, to data spying. The benefits from an IoT system should present a very attractive counterpart from the offered services. On the other side, interviewed persons expressed concrete examples of buffering systems that would allow Oilon customer service to approach field problems from the headquarters, instead of facing up the issue only when in front of the device. Also, examples of a user interface were presented that would allow inexpert monoblock burner user to understand whether main parameters are fine or in need of attention. From the interviews came up distinctively that IoT possibilities might be countless and what the company can achieve at the beginning is just a fraction of that.

The interviews revealed that those who already worked with IoT systems had already developed them long time ago, and had benefitted from types of connections related to programmed logics already present in the last century. For others, the IoT project development was just an obliged step considering competitors choices to invest in it. The IoT systems that are available in the market, had been presented to the companies interviewed but they were not in use for their limited usability. The interviewees also commented that the development reason for the competitor's IoT systems was only to show their ability to be on the crest of the wave, not to get other benefits from it. In other cases, the kickstart for IoT system's development was an obliged step considering, as mentioned before, the

long experience with comparable systems and so, the need to upgrade to a more versatile information source. Just the possibility to have access remotely to the products with IoT systems that finally did not affect their products' cost was also a reason to consider these systems. IoT turned out to be a precious resource of tools for decision support.

The data collection issue was tackled with a shared foresight on creating mutually beneficial purposes. As it is known, one crucial element of an IoT system and the service provider is to develop physics-based analytics, predictive algorithms, automation and in-depth industry expertise combined (Collin et al. 2016; 22). The exploitation is also based on the data collected and stored in the cloud of the IoT system. This discussion has seen different fronts; some have proposed their availability to share the data eventually collected for better communication, collaboration and service improvements. Other interviewees explained that data sharing should be regulated by common knowledge of its use with ultimately specific data restriction because of the sensibility of the data involved. An interesting example from one of the interviewees, which actually deal with customers placed worldwide, suggested a levelled system that would benefit from different type of service based on their availability to deal with data condivision. Sharing the data for some of the interviewees is a crucial thing when discussing IoT solution, only the use of the system, the collection of the data and the transparency on concrete benefits would bring the counterpart willing to share.

The transparency, arose the discussion towards the importance of creating a safe system without unclear spots, that provides service for the customer with improved and informative communication. This was also explained as, IoT system and services developed within it, visible clearly on the Oilon brand and strategy, allowing the customers to understand Oilon abilities acquired using the of Oilon IoT System.

All the participants interested in the IoT systems in the semi-structured interviews expressed the same positive thought on the importance of Oilon’s monoblock burner’s connectivity. All recognized a positive impact on a burner selection because in case of a IoT system, between different producers. Even if Oilon will face customers that do not want the connectivity and users who might think that their work will be undermined because of use Oilon IoT, the system will allow users to reduce downtime during its use in challenging situations, feel of control even when not on the burner’s premises and work with more peace of mind thanks to tools for notification, reports and diagnostics.

One of the intentions of the semi-structured interviews was also to bring the people involved to think about real issues related to monoblock burners performance, process and eventually give them the opportunity to express their opinion about what data they would

like to see, or how they could interact with the IoT system to achieve a better performance of the monoblock burner. Quite surprising, it came out how important the IoT system would be for them to learn more about monoblock burners; customers knew about the processes but not specifically about burners. Considering that the technology is quite robust and often they are just components of a power plant, users usually do not need to understand all the values related. However, for some of them, it would be necessary in case of troubleshooting. IoT would come handy through specific tools telling the users what the values could be to check or the reasons for failure. For them, better performance means, keeping the energy production running without expensive interruptions.

The fact is that burners do not probably face big problems during their life cycle but they need maintenance. The interviewees saw preventive maintenance as the main function for the Oilon IoT system. For most of them, it is crucial that whatever might happen to the monoblock burners during their use, the problem should be preventively noticed either by Oilon customer service personnel or customer personnel. The benefits from it are multiple, as Collins et al. (2016, 75) reminds; even if preventive maintenance is quite familiar to the companies since the old days, IoT connectivity allows specifically to:

- prevent equipment breakdown
- decrease unpredictable disruption
- execute maintenance according to the needs
- recognize underperforming equipment for making the equipment more efficient
- cut undesired travel expenses and improve production quality and power
- to improve the efficiency of equipment use
- reduce unpredictable failure
- extend the life of the devices
- Identify underperforming devices

Whether the information about preventive maintenance goes directly to Oilon customer service and then to the customer or the other way around it depends, on the type of agreement stipulated between the parts. In some cases, the customer needs and wants to have the absolute control of the process. In other cases the customer is content with the report that comes out from the service provider Oilon.

Companies interviewed who worked already with IoT systems said that the most effective way to take advantage of the system is to use it as a decision-making tool. What they mean is that through the visualization of the data on a designed and personalized UI, alarms, events and problems can be solved more quickly. They hope that the Oilon IoT will include a troubleshooting guide, for example, a tool that provides suggestions also for

a non-expert user. Still, they would like the disponibility of real-time data because they know that is the most genuine, interesting, and multi-functioning available. The possibility for the interviewees to influence what kind of data shuoul be mined, reports produced and their insight feel a priority is important for most of them. It might be a result from their experience on other IoT systems but they expresse the need of customizing based on their processes and habits.

Talking about the sensors' range, interviewees admitted the presence of two types of thinking. The first one is looking for collecting all the data available that could be useful. The second type carefully collects only the indispensable data for further analysis. The decision on what is the right way to proceed is not clear, but since getting lost on the amount of the values collected is quite real at least at the beginning, it would be wise to concentrate on the key parameters that allow a profitable service.

Monoblock burner connectivity is desired to be a support for the user and not a reason to replace him or her, as other automation systems might suggest. Still, a possibility to move faster against problems when needed and communicate better between the counterparts for a common goal is important. An IoT service can be a tool for avoiding misunderstandings and bringing transparency on severe cases, a chance to instead of losing money, address problems in development. Data exchange might create symptoms of uncertainty about reliability and a necessity for data safety in IoT. However, as demonstrated from this research, the companies who are already working with IoT systems, have achieved remarkable results in good, fast and specific support to their personnel and obviously to the customers. Proposing the system with transparency appears to be a fair requirement and allows clients to approach the appropriate type of service according to their data safety demands. Understanding what the customer's receptivity is, it will enable them to understand the benefits of the systems based on their necessity and their inclination about the use of an IoT system.

7 SYNTESIS OF THE WORKSHOPS' AND INTERVIEW RESULTS

7.1 Gigamap

The Gigamap constantly evolved while the thesis and the project develop: the elements of the different systems involved in the project were continually added to it. The Gigamap tool allows to gigantify on particular details that are under development in a certain timeframe of the project and visualise it to the group. The new findings were added on the Giga map as they emerged. (Sevaldson 2010, 2).

At the beginning of the project, the Gigamaps showed only the technological aspects developed, helping in comparing hardware and software properties. Their versatility allowed to add, meeting after meeting, decisions made and if needed, it was possible to return to the previous version of the map for a revision and update of the group knowledge.

The Gigamap expanded to another stage as soon as external stakeholder meetings were completed and again after the internal stakeholder meetings, offering already the panorama for the typology of research work to be done. The designer explained the three main focus areas in the Gigamap: the macro systems involved which explore the structures around a user of the Oilon IoT system, the macro area of external stakeholders where the semi-structured interviewed allowed to navigate on culture, opinions and needs of the stakeholders under discussion, the internal stakeholders's innovation about the values and tools of the IoT system. These three areas are under the umbrella of interactions as presented in the figure 21.

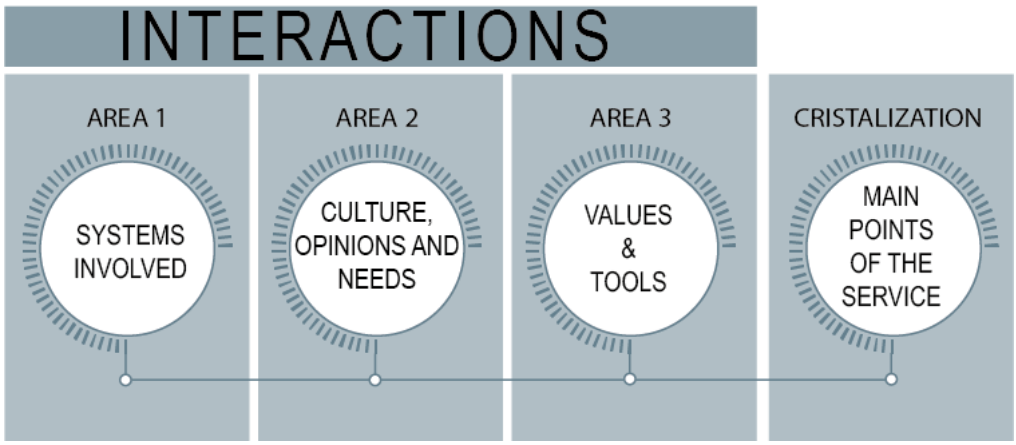

FIGURE 21. Areas of development visualized in the Gigamap (Danelon)

In the different area systems (FIGURE 22) the analysis does not go too deep iinto the facts and issues but takes care about presenting the system and subsystems connected to the user in relation with the service. Maintaining the focus on the main elements permits to concentrate on different systems and subsystems and perform the analysis on each of them when the knowledge is mature. The versatility of the Gigamaps allow to add elements, systems, that can be analysed less or more in detailed following the project development. For this reason, not all the elements in the map were considered in this thesis but will be taken under consideration when the discussion is enough mature.

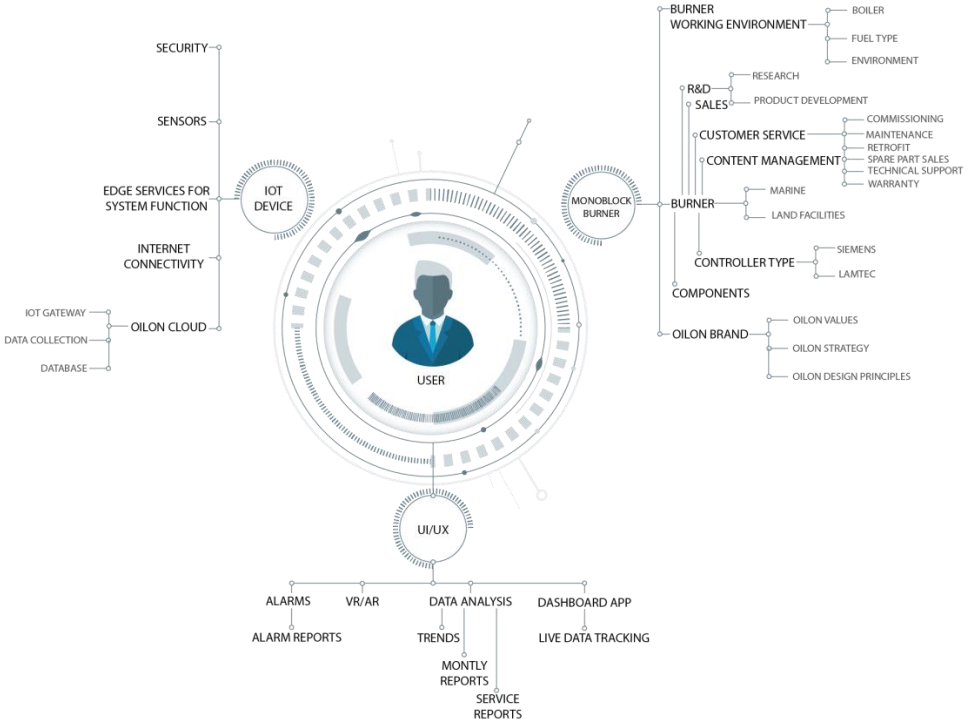

FIGURE 22. Example of area systems involved presenting the three main systems and their sub-systems (Danelon)

The semi-structured interviews have regulated the external stakeholder area of the Gigamap, presented as Culture, opinions and needs (FIGURE 23). The designer found natural to present in the map, as main points, the subject of the interview's questions. The careful preparation of the questions, followed by the participation of the project group on the validity of the subjects touched, permit a profound overview of culture attitude towards Oilon IoT, customer's opinions and needs. A significant subdivision about customers in **burners' final users**, **power plants' providers or administrators**, **dealers of mon-**

oblock burners and **boiler producers** were taken into consideration. This reflect obviously to the typology of external stakeholder interviewees. Also few representative of internal stakeholders were brought in, considering their knowledge and experience in the Chinese market and close working relationship with customers. The work done after the interviews was to bring into the Gigamaps and highlight the main points about the Culture, opinions and needs, to create visibility of gaps in between the different actors and factors and therefore fill them up with proper service.

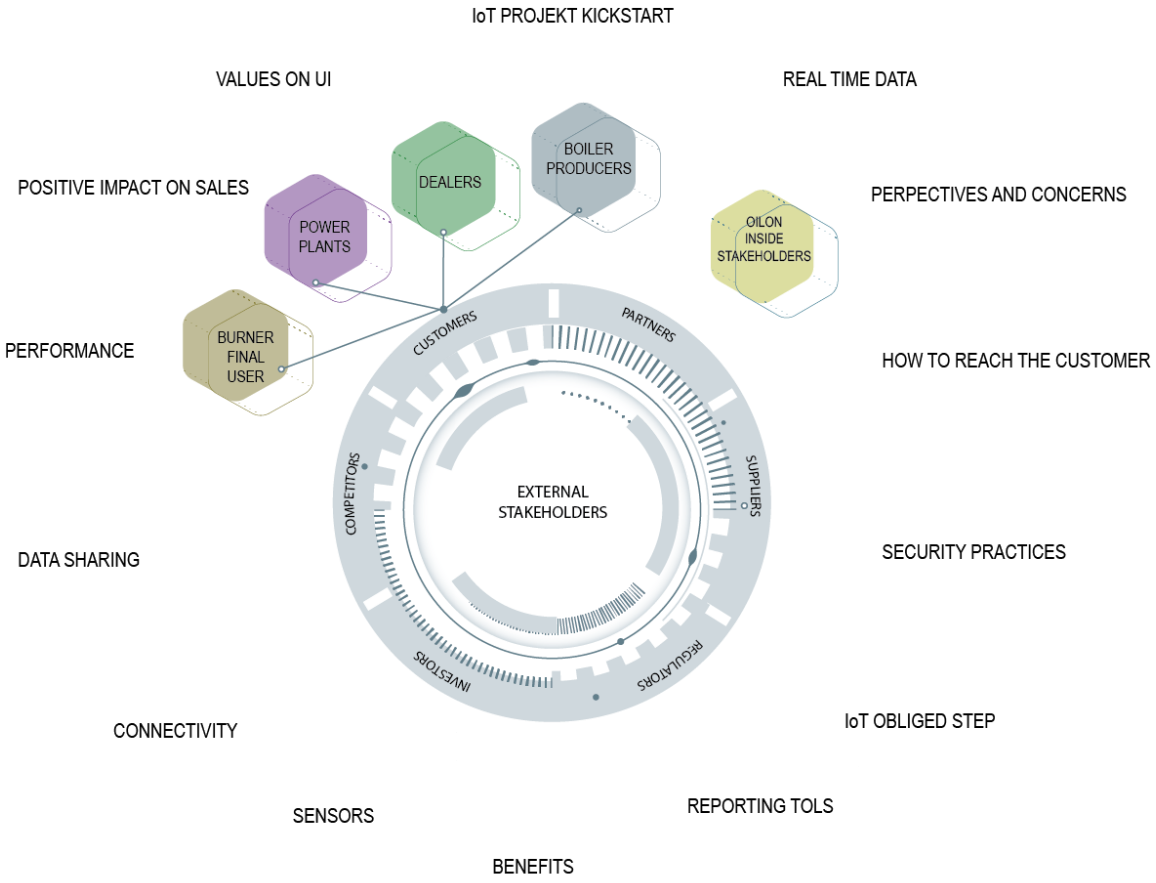

FIGURE 23. Area of Culture, opinions and needs in the Gigamap (Danelon)

The third area of the Gigamap shown in the figure 24 present the values and tools that are under discussion in Oilon IoT system. These are elements that came to evidence after the precious opportunity idea meetings where innovation workshops ideas were analysed. **Values and tools** are divided into four main development areas:

- Main process values in the user interface aggregates all the main values that the user interface might present.
- Commissioning, testing and presetting all the values and mostly tools that might facilitate this typology of actions.
- Problems, performance issues and variables that affect and activate alarms. Concentration on all the values that are sensitive for alarms that could compromise the performance
- Reporting tools, customer reach and service requirements seek for the tools and tools' characteristics that would produce customer interest and fluency for service.

The analysis performed during the opportunity meetings was challenging because it has to be thorough, considering the nature of systems and the complexity of the technical aspect. The ideation process introduced a valuable mass of ideas that had to be reshaped with costs, quality arguments and relevance of the value. The investigation continues. Once the most useful values and thei interaction are identified, the group will start concepting the services that might come along. All the results will be added to the Gigamap in any case.

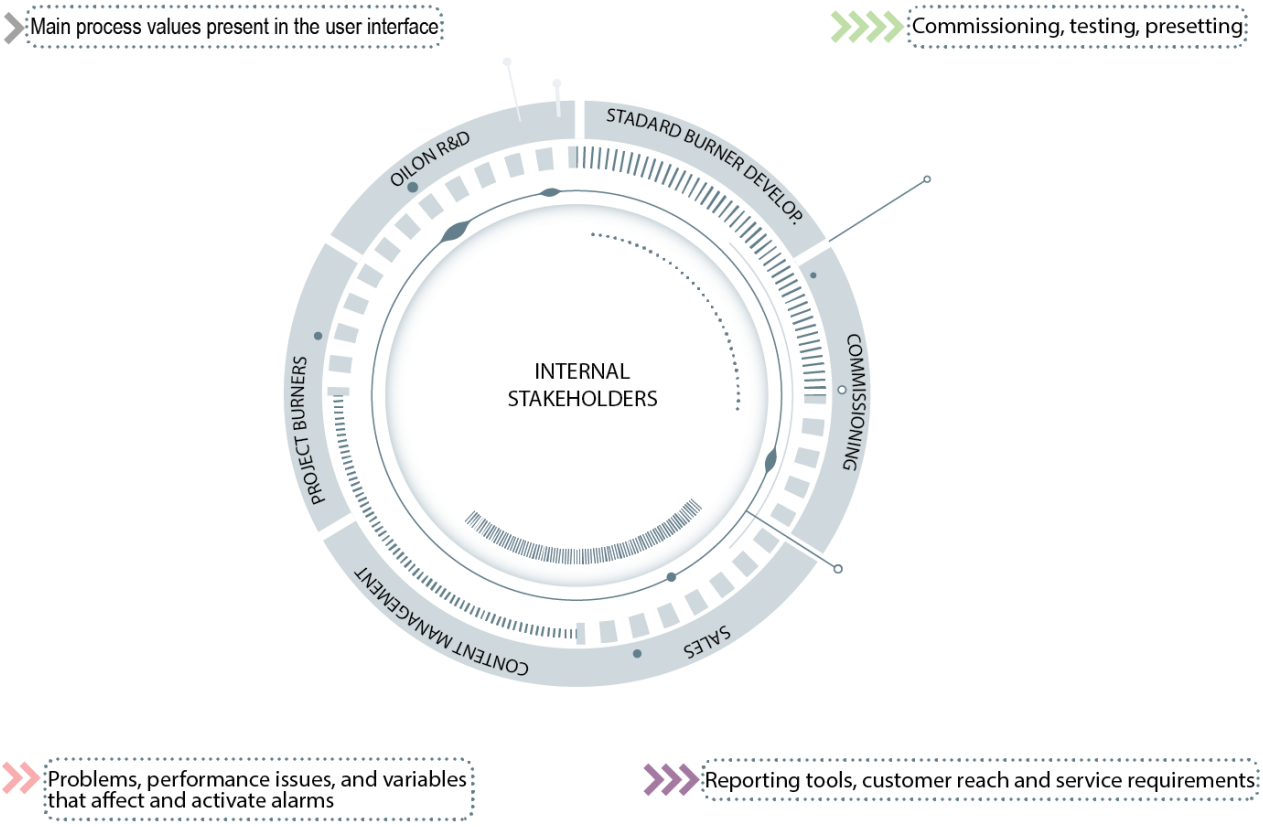

FIGURE 24. Area of values and tools in the Gigamap (Danelon)

In the Gigamap we search for interaction, the thread that connects systems, needs and values, the frame that keep experts together, keeps users and other stakeholders in the dialogue, the links that create the fluidity of the services that will born together with the IoT system.

The Gigamap is the converging point (FIGURE 25) of all the material gathered in this development work and presents the three development areas. Gigamap evolves all the time, also after the thesis. It will be visualized with further development achievements and prototype testing findings to support the business model creation and advanced service solution.

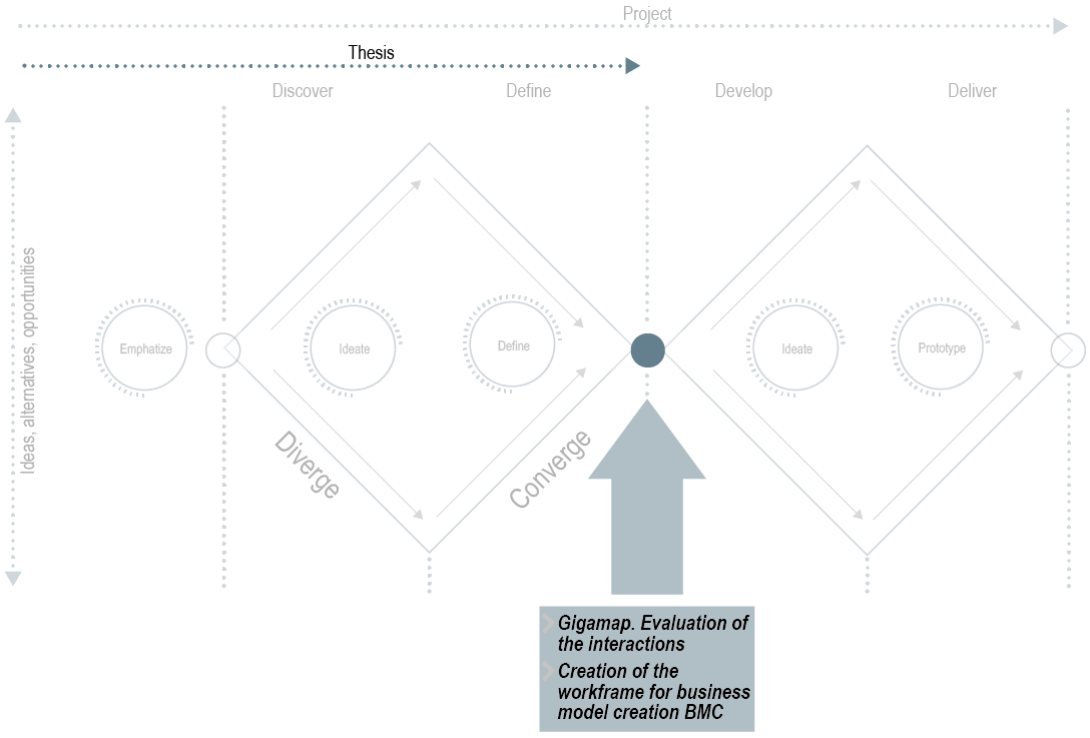

FIGURE 25. Thesis processe's outcome point for further development (Danelon)

7.2 Clarification of the findings for business model creation

Especially semi-structured interview material, had to be meticulously presented to the group in order to be taken into consideration in the further business model and service solution development work. From the analysis of the content in question, the designer graphically presented all the findings in a framework that not only explains the insights of

the work done but also activates the process for business model creation. The framework brings to evidence comments, feedbacks and desires of the interviewed persons and various aspects from other findings presented in the Gigamap. By analysing the transcribed material the designer achieved a basic understanding for proceeding on the creation of the frame-work. The graphic report allows the project group members and other company's stakeholders to understand what the Oilon monoblock clients' limits of acceptability and timely are.

The framework should be read from inside out, starting with the Oilon IoT as the heart of the concept and moving towards the different typology of users that might come across the system when using monoblock burners. What interpolates the IoT system with the users, appear to be the data through IoT service related activities of collection, analysis and visualisation. Data arouses interest, fear, attention and doubts because of its undiscussable amount of possibilities for product and service development and innovation. The semi-structured interviews of this study brought three types of customers to the surface based on their needs, wants and strategies. The framework reaveals the reasons for grouping the users into three different types and which kind of opportunities the IoT system can provide them without corrupting their beliefs or forcing their decision.

For confidiality reasons, the final service framework is not presented in this thesis report. The idea shown in the frame-work permits the approach to the IoT system model from three different levels that support each other and allow both, Oilon and its customer to begin the IoT journey with the most suitable approach. In the model, the security is represented as a dominant element, that protects the data, but does not interfere with the services offered. Proposed in this way, the framework allows the constant control and use of the security procedures but without compromising service experience, which means working constantly on the background without interfering on the customer experience.

The split levels of the framework aim at offering all company's customers the most flexible way to start gaining knowledge about their monoblock burners and at the same time, understanding the possibilities of the IoT system. Whether or not the user has concerns about the data privacy and security, the model proposed grants the opportunity to start using the Oilon IoT, without sharing the information, or sharing only in case of need of help. On the highest service level the data can be widely shared with Oilon for data excellence research and improved services. The framework allows circular thinking which means that the customers or users from the first level, once they have reached the understanding, can agree with Oilon to move forward to the use the more targeted services. For instance, for a first level customers, there will be a possibility to keep the

real-time data that comes from the burner only for themselves and the Oilon IoT will provide them with an attractive package of services. This package still assures their anonymity and provides an upgraded level of security and peace of mind. The second level customers, can obviously also profit from the same services than the first level customers, but because their availability to understand the benefits fron Oilon IoT, they might be able to share the buffered data with Oilon. Shared data grant Oilon to introduce more advanced services for the purpose of improving the customer experience but also to provide economic returns. Third level customers might be able to experience all the features that come with Oilon IoT. Within this level, real-time, buffered and cloud-stored data is always available and interfaces tailored based on the customer requirements. Preventive maintenance was presented as a major tool and desire from the interviewees when using IoT systems. In the future extended collaboration for precise service development with the different levels of customers will be organised under the design thinking approach. Levels are not barriers, but launch pads, all three benefit from each other, and customers can profit from the type of service that feels more appropriate for them.

Another essential part of the model presented is that it works as a reminder for the developers and subsequently for the sales team. Understanding data and IoT system's, in general, can be very demanding. Proposing it to the market requires transparency about the features, a very informative atmosphere and competence demonstrations. The model presents a 360-degree view for possibilities, approach, usability, experience, service offering and innovation purposes guiding the project group through to the actual Oilon IoT business model and IoT service system.

8 CONCLUSIONS AND REFLECTIONS

Did the developments task achieve the expectations of the project group? Did the methods involved bring in the right tools? Did the research questions find enough answers? The designer at the end of the development work started asking himself whether the choices done were thoughtful and served the purpose. Watching back through the process, the designer sees four main phases where to reflect on how the work succeed in meeting the challenges during the research and development process described in this thesis. **Identifying the right users to design for** was the obliged step to initiate the process. Taking the project group on a quite in-depth analysis of the audience that could be involved from that moment on, opened up the challenge, understanding how distantly and how closely involved the diverse stakeholders were. Through active stakeholder cooperation, competitive advantage and ability to manage stakeholder relationships was achieved effectively. The results providing valuable information and ideas were seen during co-design meetings and semi-structured interviews, with the participation of different Oilon departments and external stakeholder, wisely chosen. The achievement was not only the active participation but the ability to manage the stakeholder relationships by understanding the value of the interaction. The act of recognizing stakeholders during the meetings was profitable, but the designer admits the need for practice; mostly, external stakeholder recognition was not as effective as expected. Stakeholder analysis is meant to be executed at different times for controlling whether stakeholder relationships have been changing. The possibility to proceed with a new investigation before deepening into the business models could clarify the situation again.

The methods' selection for the **acquisition of the empirical material** was made with the vision to bring to the project the users' point of view, as much and as clearly as possible. With the design thinking approach in mind, semi-structured interviews and co-design workshops concretised the need. Realising and shaping the tools used for the acquisition of the empirical material took quite a lot of effort from the designer. The challenge here for the designer was to offer tools that would tackle the technical side but still push the persons involved to see over it and reach the unexpected. Also, the opportunity for the designer to implement methods and tools from design thinking methodology into the company's R&D was unique, since a technical orientation and a strong tradition in engineering were predominant in the company culture. As Miettinen (2017, 34) states, the typical way to introduce service design into a company is through pilots, and this project was the opportunity where staff and management could understand whether or not the methodology and the pilot itself serve the purpose and supported the company strategy. What had been

done until now in this development work, it is just the ground that supports the decisions that will be made in the future, when actual design for service specification methods and tools will be applied. The designer, mostly during this phase, had to demonstrate the efficiency of the techniques in use, taking into consideration the usual engineering-based development procedures might reach results faster and certainly be less intrusive. As Miettinen (2017, 138 - 140) points Rönnhölm's ideas, development work typically stays in the development silo where certain specialists control it. If we work in a project based on customer demand, the interaction between people and technology becomes alive illuminating also many unexpected barriers. Tackling problems and barriers before implementation is convenient and successful for the project. Projects that have not had the holistic view provided with design thinking, often on paper seem easy, but then real challenges start when implemented. This is the difference of design thinking compared to traditional, efficient, but siloed development methodology. The positive participation of the people involved in co-design happenings made the work remarkably interesting, between people, when looking for richness and diversity of content. All the tools presented stimulus for development ideas and made them useful, but they also need modification. Fortunately, in all of them, there was elasticity for small changes.

Analysis of the empirical material and the opportunity creation meetings were the most intense and resource-consuming activities but also the most tangible and fulfilling work that opened up the new possibilities. Reading through the text, analysing it and working in parallel between the different sources gave the designer the feeling of resolving the fuzzy first part of the project. From now on, there would be something palpable to build the system on. Clustering ideas from the interviews and digging more in-depth during the opportunity idea meetings brightened the scenario to work on. There was a clear distinction between the different materials and analysis prosecuted; working on the interview material from external stakeholders, cleared up mostly behaviours, habits and empathy towards an IoT system when opportunity meetings focused on the technical side of the system development. Both areas support each other when looking for the interconnections in between. The material was divided in sense making ways when piled up for analysis, and the fact that all was recorded gave a sense of tranquillity that the discussed was reported on the Gigamap or as group working tools. With the purpose to create a congenial work environment, the designer always first analysed the raw material and in case of need produced tools for the group to work. The objective was to provide tangible results fast.

This development work ended up with a structural review and update of the Gigamap. During the whole development process, Gigamap tool was utilized and kept up to date but

working on the map after the analysis of the empirical material force the designer to re-design the whole structure of it. **Findings on the Gigamap for new business models analysis** enable the group to see all the phases of the work and investigate close in case of ruptures. In the beginning, only technology achievements were presented on the maps; they were basically a graphic memos of what had been done previously. The designer didn't really understand the potential of the tools until he started analyzing the empirical material. The power of the maps came out when stakeholders' expectations were inserted. The approach through Gigamaps was visual. Visualizing data, as Stickdorn et al. (2011, 111) mention, brings structure into complex data allowing the team to get an overview of the amount of the information. The designer decided to propose to the project group the Gigamap already summarized instead of presenting the analysis work with some other means. Considering the novelty of the techniques, the designer preferred to show the results for the project group so they can directly see its potential. The result was a positive understanding from the project group about the fact that the work executed until now, functions as support for the value proposition of the business model that operates around the Oilon IoT.

Technology is the necessary condition for growth, and it is an incentive for the energy transition, but the steps of the energy supply chain are becoming increasingly digitalized. In the future, the data will be crucial to get to know the customers and provide them with a better service. The digital transition passes mainly through people. Citizens are taking advantage of the internet of things, companies are chasing these new technologies, and the growth of renewables makes the network of energy decentralized, intelligent and connected. Collecting data but not using it to improve the different areas that support the various systems is not sustainable; data is the real asset that will allow companies to get to know the customers. Besides, analysing data and trends allow the possibility of reducing imbalanced charges to a minimum and proposing targeted offers to customers with an estimate of the probability of success. The Oilon IoT systems can be the link between monoblock burners' robust and proved energy technology and the spectrum of all the new energy resources that are conditions of a desire for greener and more respectful use of energy.

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APPENDICES

APPENDIX 1

			LOGISTICS		R&D						CUSTOMER SERVICE			PRODUCTION						
		Stakeholder Name	WAREHOUS	PURCHASING	STANDARD BURNERS	RESEARCH and LAB TESTING	PROJECT BURNERS	CONTENT MANAGEMENT	HR	SALES	SPARE PARTS	CUSTOMER SUPPORT	COMMISSIONING	PRODUCTION DEVELOPMENT	PRODUCTION TEST	PRODUCTION ASSEMBLY	FINANCIAL	IT SUPPORT	OILON OWNERS	OILON MANAGEMENT
		MARK FOR MAPPING	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
		Questions for opening internal stakeholders analysis discussion.																		
1		**Influence on the project?**	**0,3**	**0,3**	**1,3**	**1,3**	**1,3**	**1,2**	**0,3**	**1,0**	**0,3**	**0,7**	**1,0**	**0,5**	**0,3**	**0,3**	**0,3**	**1,0**	**0,3**	**0,3**
1	1	Does it have the expertise in the field?	1	1	4	4	4	3	1	3	1	2	3	1	1	1	1	3	1	1
1	2	Does it have important information about the technology?	1	1	4	4	4	4	1	3	1	2	3	2	1	1	1	3	1	1
1	3	Could it support the project plan?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	4	Is it responsible for the plans of the project?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	5	Does it controls the implementation tools?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	6	Does it have the power to end the resources?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2		**Affected by the project result?**	**0,0**	**0,0**	**4,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**
2	1	Does it get benefit from the project?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	Is interested in the result of the matter?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Key stakeholders - Total	0,3	0,3	5,3	1,3	1,3	1,2	0,3	1,0	0,3	0,7	1,0	0,5	0,3	0,3	0,3	1,0	0,3	0,3
		To which stakeholders ***Oilon CloudI*** creates value																		

stakeholder input

4 = very important, 3 = important, 2 = meaningful, 1 = not relevant

TO BE FILLED UP

		Question		Stakeholder	Value	Reasons for the value
1	1	Does it have the expertise in the field?	A	WAREHOUSE	1	
			B	PURCHASING	1	
			C	STANDARD BURNERS	4	
			D	RESEARCH and LAB TESTING	4	
			E	PROJECT BURNERS	4	
			F	CONTENT MANAGEMENT	3	
			G	HR	1	
			H	SALES	3	
			I	SPARE PARTS	1	
			J	CUSTOMER SUPPORT	2	
			K	COMMISSIONING	3	
			L	PRODUCTION DEVELOPMENT	1	
			M	PRODUCTION TEST	1	
			N	PRODUCTION ASSEMBLY	1	
			O	FINANCIAL	1	
			P	IT SUPPORT	3	
			Q	OILON OWNERS	1	
			R	OILON MANAGEMENT	1	
1	2	Does it have important information about the technology?	A	WAREHOUSE	1	
			B	PURCHASING	1	
			C	STANDARD BURNERS	4	
			D	RESEARCH and LAB TESTING	4	
			E	PROJECT BURNERS	4	
			F	CONTENT MANAGEMENT	4	
			G	HR	1	
			H	SALES	3	
			I	SPARE PARTS	1	
			J	CUSTOMER SUPPORT	2	
			K	COMMISSIONING	3	
			L	PRODUCTION DEVELOPMENT	2	
			M	PRODUCTION TEST	1	
			N	PRODUCTION ASSEMBLY	1	
			O	FINANCIAL	1	
			P	IT SUPPORT	3	
			Q	OILON OWNERS	1	
			R	OILON MANAGEMENT	1	

APPENDIX 2

oilon

Interview - 1

IoT Knowledge

Are you familiar with IoT Systems? What kind of perspective and possibilities you can see if implementing an IoT System in burner technology? (picure support for explanation if the answer is no. In this case the second question will be skipped)

IoT Value

The Oilon IoT might provide also communication between different components of the process system. Do you have already IoT system in your company? Which kind? Do you have suppliers / partners / businesses that offers an IoT system or are planning to do so? If you have devices connected, what types of benefits the IoT systems is providing you?

IoT Use

Do you think a daily/weekly/ monthly report from the IoT system would be enough?

OR do you think alerts, real time data visualization are essential?

Do you think remote control functionalities are essential?

Do you wish to have a mobile app for data visualization that is stored on the cloud?

What are the security practices/solutions in you IoT systems?

Are you willing to share with Oilon the data collected from the burner for process development?

Are you concern about connection costs, if they will be applied?

Do you see the IoT system technology an obliged step in the future of burner development?

IoT Ecosystem

Would Oilon products connectivity have a positive impact when making burner selection? If yes, does your answer take in consideration the ability of Oilon's visionary approach to new techniques?

IoT Use

Considering burner working surrounding and location, do you think that Oilon IoT system will face lack of internet connectivity? Can you make an example of a possible situation?

Element board

(ideation and prioritisation)

IoT Use

You have the freedom to ideate whatever you like, what would you like to get from the possibility to interact with the burners? (Pictures support)

APPENDIX 3

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Interview - 2

IoT Value

What was the kickstart of your IoT project, real needs for the boiler technology (possibilities not available before), customer's needs or a change in the energy sector?

IoT relations and channels

How have you reached your customers at the beginning when you implemented you digital system? What are the most important factors/feature that influence your customers' opinion about your IoT systems?

IoT Customer

Which customer segment do you serve with the IoT system that you developed? Have you noticed any interest from customer segments that were not in your expectations?

IoT relations and channels

Which one has been the most effective way to communicate the implementation of your digital systems?

Element board
(ideation and prioritisation)

IoT Value

Would Oilon products connectivity have a positive impact when making burner selection? If yes, does your answer take in consideration the ability of Oilon's visionary approach to new techniques? How did your customers react towards the implementation of IoT system on your products?

IoT Use

How do you see the combination of IoT systems for a common end client?

IoT Use

Considering burner working surrounding and location, do you think that Oilon IoT system will face lack of internet connectivity? Have you face this issue with your system? Can you make an example of a possible situation?

IoT Use

You have the freedom to ideate whatever you like, what would you like to get from the possibility to interact with the burners? (Pictures support)

APPENDIX 4

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Element board

How would you comment the possible benefits that an IoT system connected to an Oilon burner could achieve.
Could you please also think about some real issues that could support the introduction of this services?

Monitoring

- **Better performance of the burner/processes** (more accurate monitoring of the process, real-time operation, Can you tell me the five process values that you want to be the first to see in the Oilon IoT UI that can be used to track the process?

ideas - comments - examples

Reporting tools

- **Reporting tools as specific statistics and reports** (Consumption and cost of fuels per hour/ day/month/ year, for single and for multiple burners, Production of energy and value of it per hour/day/month/year, performance comparisations, combinations of the status reports).

ideas - comments - examples

Remote alarm processing

- **Machine condition status** (tailored alarms whenever certain variables or smart indicator alarm levels are reached) (compromised performance issues localised and adjusted by Oilon) How would you like to be reached?

ideas - comments - examples

APPENDIX 5

Laitteen kunto - parempi prosessiturvallisuus

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- räätälöidyt hälytykset aina, kun tietyt muuttujat tai älymittareiden hälytystasot on saavutettu / - tulipesän tila tai ympäristön olosuhteet laukaisevat hälytyksen

KIRJOITA TARRALAPUILLE IDEOITA JA LIIMAA NE HARMAALLE ALUEELLE.

ANTAKAA TEIDÄN KOKEMUKSIA, ESIMERKKEJÄ JA REAL CASE TAPAHTUMIA KYSYMYSTEN AVULLA

Mieti polttimia, kattiloita ja ympäristöä.

Mitä hälytyksiä esiintyy yleisimmin?

Miksi niitä tulee? Ovatko hälytykset kustomoituja, ovatko ne samoja kaikissa monoblock-polttimissa?

Mitkä muuttujat vaikuttavat hälytyksiin ja aktivoivat ne?

Mitkä ympäristöolosuhteet laukaisevat hälytyksiä?

Mitkä arvot laukaisevat hälytyksiä ja mistä ne tulevat?

Kuinka nämä tulisi visualisoida?

MITÄ OLISI HYVÄ SAADA OILON IoT:HEEN JOTTA

- räätälöidut hälytykset laukaisevat (mitkä muuttujat, älymittarit ja olosuhteet)

LIEKKI

- Liekkisignaali
- Liekkisignaali taso
- Palamisen hyötysuhde (ohjaimen laskemana)
- NOx
- Häkä
- Happi optiomittaus

POLTIN

- Tilausnumero
- Poltin tyyppi
- Polttimen sarjanumero
- Savukaasunkierrätys (FGR)
- Polttimenajotila
- Polttimen minimiteho
- Polttimen maksimiteho
- Polttimen tehopiste
- Puhaltimenpyörimisnopeus (VSD)
- Häiriökoodi
- Käynnistyskerrat
- Käyttötunnit

KATTILA

- boiler ok = turvapiiri kunnossa
- Kattila tyyppi
- tulipesän paine (käyttöönoton yhteydessä pitäisi tehdä käyrä)
- Kattilaveden lämpötila tai paine, oloarvo/asetusarvo
- Kattilan uloslähtöteho: virtausmittari, lämpötilat(meno/paluu): Signaali ok
- Kattilan hyötysuhde (tarvitaan ympäristön lämpötila)

ei saatavilla signaalia

- Öljyn määränsäätöventtiilin asento
- Kaasun määränsäätäventtiilin asento
- Ilman määränsäätö asento

YMPÄRISTÖ

- ympäristön (palamisilman) lämpötila
- Valoanturi
- Liiketunnistin
- Infrapuna-anturi
- Ääniantturi
- Kosteusanturi
- Painoanturi
- Häiriökoodi
- Kattilahuoneen paine on/off tieto, matala;

HUOLLOT

- Öljysuodattimien kennon vaihto: painetieto (alue?), 1 v tai 2500 h
- Kaasusuodattimen kennon vaihto: painetieto (alue?), 2 v tai 5000 h
- Nestekaasuajat kuten öljyllä
- Öljysuuttimien vaihto, 1 v tai 2500 h
- Öljyletkujen vaihto, 5 v tai 15000 h
- Painekytkimien vaihto, kaasu, 8 v
- Ilmanpaine-erokytkimen vaihto, 8 v
- Ohjausautomatiikkayksikön vaihto, 10 v, 250.000 käynnistystä
- Säätömoottorit, 2 000 000 edestakaista liikettä --> 10 v
- Kaasuventtiilien vaihto: 10 v tai 250.000 käynnistystä
- Sytytyskärkien ja -johtojen vaihto: 5 v, käynnistyskerrat 100000 kpl
- Öljyn painelähettimen: 10 v
- Lämpötila-anturin vaihto: (Pt1000) 10 v
- Tiiviydenvalvonta 10 v tai 250.000 käynnistystä
- O2-anturin vaihto: 2 v, 8000 h
- Liekinvalvoja 3…4 vuotta 100000 käynnistystä
- Palopään jatkeen vaihto: 5 v tai 13000 h
- Polttimen määräaikaissäätö: 1 v tai 2500 h

KOMPONENTIT

- Ohjaimen tyyppi
- puhallin/kanava paine, ei mitata
- Sytytysventtiilin ohjaustieto
- Sytytysmuuntajan ohjaustieto
- Öljyventtiileiden ohjaustieto
- Kaasuventtileiden ohjaustieto
- Puhaltimen ohjaustieto
- Öljypumpun ohjaustieto

POLTTOAINEET

- Polttoaineteho tehopisteen kautta mittaus vakiona kaikissa
- Öljyn säätökäyrä tehon suhteessa
- Kaasun säätökäyrä tehon suhteessa
- Ilman säätökäyrä Öljyn suhteessa
- Ilman säätökäyrä Kaasun suhteessa
- Valittu käyrä (polttoaine)
- Savukaasulämpötila optiomittaus
-polttoaineensyöttöpaine optiomittaus (vain jos plc)
- kaasusuutinpaine
- öljyn sumutus- ja paluupaine
- Kaasun syöttöpaine matala
- Öljyn syöttöpaine matala
- Puhallinpaine matala

APPENDIX 7

Areas of development	IDEA or VALUE	WHY	BARRIERS	QUESTION	Interaction	What is its added value?	A thoughtful implementation way	Hardware	Additional Sensoring	Software	Cost Effect (0-3)	Qilon	Customer
		Why certain idea or value was interesting	*What barriers the idea or value sees*	*How might we bolde over the barrier*								***Valuation*** *0 = no value 1 = nice to know 2 = provide added value 3 = very important*	***Valuation*** *0 = no value 1 = nice to know 2 = provide added value 3 = very important*
5 process values visible in the user interface.													
	IDEA or VALUE A												
	IDEA or VALUE B												
	IDEA or VALUE C												
Problems, performance issues, and variables that affect and activate alarms,													
	IDEA or VALUE D												
	IDEA or VALUE A												
	IDEA or VALUE E												
Reporting tools, customer reach and service requirements,													
	IDEA or VALUE D												
	IDEA or VALUE C												
	IDEA or VALUE E												
Commissioning, testing, and presettings													
	IDEA or VALUE A												
	IDEA or VALUE B												
	IDEA or VALUE E												